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THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit Correspondence for publication from all among them who make the study of these subjects a pleasure, or a profession.

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NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

OFFICIAL NOTICE.

The annual meeting of the Association will be held at the Tremont House, Boston, on Wednesday, February 20th, 1878, at 12 o'clock, noon.

At the last annual meeting of the Association it was voted that the sum of fifty dollars be paid from the funds of the Association to the member presenting the best original dissertation upon any subject connected with the manufacture of illuminating gas, from substances of which coal is the principal ingredient.

A further sum of fifty dollars was offered by Geo. D. Cabot, Esq., late President of the Association, to be devoted to the same purpose; thus making the prize or reward for the best dissertation, as stated above, one hundred dollars.

Members intending to compete for the prize are requested to forward their papers to the Secretary, at least one week before the time of the annual meeting, in order that he may lay such papers before the Directors for their inspection, giving them ample time for examination, and for a fair and careful examination of their comparative merits.

At the same meeting a special committee was directed to prepare a list of questions relative to the operations of the several companies under the charge of the different members of the Association; and that the Secretary cause said questions to be printed in convenient form and distributed among the members, to be answered by them and returned to him in season for their tabulation and presentation to the Association, at the next annual meeting. These questions will be forwarded to each member in a few days. The undersigned requests that the blanks may be filled out and the papers returned to him on or before the first day of February next.

The answers, in compliance with the wish of the committee, must be based upon the business of the year 1877, except in the case of those companies which do not close their financial year with the secular year. Their answers may be based upon the business of their financial year which closes the nearest to the date of this notice.

Members intending to propose any persons for membership at the annual meeting, are requested to send to the Secretary the names of such persons as soon as possible.

GEO. B. NEAL, *Secretary*,
BOSTON, Jan. 1, 1878.

THE RELATIONS BETWEEN MUNICIPALITIES AND GAS COMPANIES.

His Honor, Mayor Ely, of New York, in his Annual Message, delivered to the City Council at the beginning of the present year, made the following statement:

"In other large cities the gas companies are made a source of revenue. The gas companies of Paris pay to the city about $1,700,000 annually."

A fuller enquiry into the relations existing between the Municipality of Paris, and the gas interests connected with it, would have shown his Honor that, aside from the revenues, there were other very important differences between Paris and New York in this matter. In the first place, and above all, Paris is afflicted with but one gas company; so that there is an inaccuracy in the message in speaking of gas companies. This single company has the exclusive privilege of making and selling gas in the various communes of Paris until 1905.

They have ten sets of works, in various parts of the city, and the gas made by them supplies 50 communes in the departments of the Seine and Seine et Oise. Of course all these works are managed by a single administration. The company is operated under a "concession" from the Municipality, under which, after paying all interest, charges, etc., and a dividend to the shareholders of about 12 per cent, one-half of all profits, over and above the 12 per cent. dividend, goes to the shareholder, and the other half is paid to the city of Paris. This is the way that "the gas companies of Paris pay the city about $1,700,000 annually.

The amount paid for the year 1876 was $1.660,-000, while for the previous years it was proportionately less, according to the amount of gas sold.

For a full report of the operations of this company, for the year 1876, we refer to our translation of the Report of the Paris Gas Company, which was published June 2d, 1877, p. 207, vol. XXVI.

In this Report every gas maker will find many other differences between our works and those of the French capital. The receipts for residual products, the manner in which fixtures are put up and controlled by the company, all make a very great difference in the balance sheet, but the fact that the company holds a concession by which a single administration conducts the operations incident to the gas manufacture of the whole city is the important one to be viewed by our legislators.

Competition in the manufacture of gas in any single community is "a delusion and a snare." It never results in permanent reduction of price to the consumer. It does result in a waste of capital, and in setting two men to do that which could be better done by one. Nothing could conduce more to reducing the price of gas to consumers in this metropolis, or any other community having more than one gas company, than to unite the whole under one management, with a capital that should represent fairly the real value of the necessiraly employed to do the work required. This may be a proposition difficult to arrange, but when it is accomplished, then cheap gas may be had in New York and elsewhere.

RECOVERY OF MR. SAMUEL P. PARHAM.

A few months ago we announced the very serious illness of Mr. Parham, the Engineer of the New York Mutual Gas-Light Company. We are very happy to announce to our readers, and his many friends, that we received a visit from him a few days since, and it will be a pleasure to all to know that his health is restored and that he is again able to attend to business. He continues his connection with the Mutual company, to whom his recovery must be exceptionally gratifying owing to his large experience and long connection therewith.

MR. JAMES SOMERVILLE.

We are happy to learn, from an official notification by the Secretary of the Montgomery, Ala., gas-light company, that that company has been fortunate enough to secure the services of Mr. Somerville, late of Knoxville, Tenn., as superintendent of their works. The Secretary announces that the company is prepared to furnish "a full supply of gas of the best quality." The notice also calls the attention of consumers to the condition of their fixtures in the following words: "Where the lights are not good the defect is in the fixtures and not the gas. All orders for repairs, through the mail or at the office, will be promptly attended to."

If this is Mr. Somerville's first move in taking charge of the new position, we congratulate him upon starting reform in the right direction, and we trust he may be successful in establishing such relations between the consumer and the manufacturer, that when the former desires to be properly instructed as to the best methods of burning gas, they will seek that information where it can be found to be of a reliable and correct character.

There is much truth in the statement that as much, if not more, depends upon the fixtures than upon the gas; at any rate poor ffxtures will ruin the best of gas.

[Communicated Article.]

A Gas Works Submerged.

Mr. Editor: The writer, an old gas man, was passing through the City of Richmond, Virginia, a few weeks ago, and having read in the newspapers voluminous accounts of the great flood in the James River, concluded to stop to exchange salutations with friends connected with the gas works, and enquire what damage was done them by the irrestible flood of November, 1877.

It was the greatest in a hundred years, and from which, for many years to come, the people of the James river valley will remember notable events as occurring before or after "the year of the great flood."

At the gas works I found the energetic and courteous Superintendent, Mr. Jno. P. Knowles, and all his men, busily engaged in cleaning up and repairing the damage caused by this mighty force of Nature.

I am indebted to the Hon. John M. Higgins, the enlightened chairman of the gas committee, Mr. Knowles, and some of his assistants, for the information I received, which I think will be interesting to the readers of so valuable an organ of the gas interest as your Journal.

On the 24th of November Mr. Knowles was informed by telegraph from Lynchburg that the waters of the upper James river were rising with unprecedented rapidity, by reason of the heavy rains in that part of the country. He having acquired valuable experience by the freshet of 1870 at once began to prepare for what he believed was coming, by giving orders, in no uncertain sound, to remove everything movable at both the works (upper and lower) that the water might injure or carry away; he also had the caps taken off the stand-pipes of all the retorts in action, and had the "decks cleared" generally for the worst that might come. The wisdom of this course was plainly seen, for before the preparations were entirely completed the water came rushing into the lower part of the city and gas-works so rapidly that it soon rose to a height of 10 or 15 feet in the neighborhood of the works, and the officers and men were soon compelled to attend to the duties of the occasion in boats, and continued to do so till "the dry land appeared." "It was a curious sight to see men rowing boats all round the yard and in the retort house."

The entire works were submerged, and by two o'clock, on the morning of the 25th, all the fires were drowned out, and the water was soon above the top retorts in benches of "fives." The hands relate with curious interest that strange "crackling," and miniature explosions, took place as the water gradually rose in the red hot furnaces round the heated retorts. The noise, they say, was continuous, and could "be heard a block off until the ovens were nearly stone cold."

The water began to subside on the night of the 26th, and on the morning of the 27th, at 7-30 o'clock, having fallen below the grate bars, the order was given to *fire up*, and in 36 hours the heats on the retorts were sufficient to charge them. This being done every one expected to find the retorts cracked and leaking, by the sudden contraction to which they had been subjected. What will interest our gas friends most is the fact that notwithstanding the retorts were cooled and heated in the time and manner stated, not one was broken or seriously cracked, and at the present time are doing ordinary service.

Men less bold than Mr. Knowles would have hesitated before pushing matters so promptly. It was a dernier resort, however. There was the City of Richmond, and its valuable interests, jeopardized by utter darkness at such a time. Two or three miles of the largest mains full of water, and the retorts as cold as death. The doctors say "heroic treatment" is sometimes necessary, and in this case won; for, in 36 hours after the furnace fires were lighted, the citizens of Richmond were lighting their gas with an unexpected pleasure that they had never dreamed gas capable of inspiring. Here I would add, by way of moral, "we never know the valne of the water till the well goes dry."

Many incidents were related which, if told as they were told to me, would make an interesting story without the aid of fiction; fear of trespassing on your space forbids, and I will only mention two—

When the benches began to warm up a moccasin snake, more than two feet long, crawled out of one of the stopper holes, and was killed on the floor by one of the men. A wild goose was captured swimming in the yard of the upper works.

Mr. Knowles attributes the safety of his retorts to the removal of the caps on the stand-pipes, thereby preventing steam pressure or explosions within.

The gas works are owned by the City of Richmond, and the fact that gas of excellent quality is sold at $2.50 per thousand, and more than $50,000.00 of the earnings of last year was profit to the city, and went into the city exchequer to help to defray general expenses, shows that the committee and superintendent who manage the works understand their business.

PHILADELPHIA, December 28th, 1877.

On Steam Boiler Explosions, and Experiments Relating Thereto*.

By DR. HERMAN SCHEFFLER.

The author is disposed to refer many boiler explosions to the creation of a marked disproportion between the external pressure acting on the boiler water and its internal temperature. This may act in two says: [1] as a primary cause of explosion where the taking off of the pressure produces a sudden and violent generation of steam, the shock of which is greater than the boiler can withstand; [2] as a secondary cause where a rent in the boiler produced by some other means creates the disproportion, and the ensuing generation of steam comes in to render the explosions much more violent and destructive. The second fact is generally admitted, but as to the former there are great differences of opinion, and it is therefore desirable that the point should be cleared by actual observation on the fluctuations of pressure and temperature occurring within steam boilers under various temperatures.

With this view the writer affixed three thermometers [made specially for the purpose by Messrs Schaeffer and Budenburg] to different parts of the boiler of a locomotive, viz., one in the front of the boiler, close to the entry of the feed-pipe, and, therefore, where the lowest temperature might be looked for; the second about the middle of the length of the fire-tubes, where the temperature would probably be highest; and the third in the front of the fire-box near its top. A large series of observations were taken of these thermometers, and at short intervals. The results are embodied in a table, which gives for each observation, [1] the actual pressure at the moment as given by the pressure gauge, in atmospheres; [2] the readings of each of the three thermometers; [3] the theoretical pressure of steam corresponding to each of these temperatures, as calculated by the formula of Regnault. The observations fall into four groups, according to the following conditions: [A] engine standing, feed shut off; [B] engine standing, and feed going on; [C] engine running, feed shut off; [D] engine running, feed going on. Separate observations were taken with three different descriptions of feed apparatus, viz.: an injector, a plunger pump, and two plunger pumps combined Separate series of observations were also taken when the pressure was rising, and again when it was falling.

The pressure as given by the gauge in every case differed from the theoretical pressure de-

* From Transactions of the Institution of Civil Engineers London England.

ducted from the temperatures. As the latter always varied among themselves, exact agreement was of course impossible; but this was not enough to account for the differences observed, which may possibly be attributed to defects of the gauge, but should rather be taken into account among the general results of the experiments. These are as follows:

1. When the feed was shut off, whether the engine was standing or running, the thermometers at the fire-box and in the middle of the boiler gave very nearly equal readings. At the smoke-box end the temperature was somewhat lower, but the difference was not above 5°.

2. With the feed shut off, but with rising temperature and pressure, the indicated tension of steam in the steam space was about 0.2 atmosphere [3 lbs.], higher than the theoretical pressure at the hottest part of the water: with falling temperature and pressure it was about as much lower.

3. When the feed was opened the temperateres at the three places fell unequally; the fall being least in the middle, greater at the fire-box, and greatest at the smoke box near the entry of the feed-pipe.

4. Where the feed was effected by an injector, these differences were least, not exceeding 7°; with a single pump they amounted in some cases to 9½°, and with two pumps to as much as 17½°, corresponding to a difference of pressure of 2½ atmospheres [about 35 lbs].

5. A fall in the temperature of the water was in all cases followed by a fall in the tension of the steam; but when the cooling was rapid this fall was less in proportion to it, so that the actual tension became higher than the theoretical pressure at the points of observation. The greatest difference so observed amounted to 2½ atmospheres.

6. While this held in general, there were cases where, at the commencement of the feed, the theoretical pressure at the hottest point was for a short period higher than the actual steam tension, the greatest difference, however, not exceeding 0.43 atmospheres.

7. When the injector was used the temperature of the feed-water, immediately before entering the boiler, was from 40° to 60° higher than that of the tender-water. This, of course, accounts for the inequalities of pressure produced by an injector being much smaller than by a pump.

8. A sudden opening or closing of the regulator produced an instant fall or rise of the pressure gauge of about 3 lbs., or 1½ lb. respectively, followed in general by a slight recoil towards the original standpoint.

9. The opening of the regulator caused a rapid fall of the thermometer which at the moment stood highest, and a rise of that which stood lowest, amounting in each case to about 3½°, thus producing an equalization of temperature to the amount of about 7°.

The following general conclusions are drawn from the above by the writer:

1. The supply of water by feed-pump causes large variations of temperature in the different parts of a boiler. These act on the steam tension but with the general result that this tension is decidedly in excess of the theoretical pressure due to the water temperature; thus fortunately tending to retard, and not to accelerate, the generation of steam.

2. At the first moment of opening the feed the converse is observed, the steam tension being about 0.4 atmosphere in defect of theoretical pressure. The same holds to a smaller extent when the feed is shut off, provided the temperature and pressure are falling at the time.

The explanation of the above facts is obvious. When the pressure is lessened by the steady abstraction of steam it falls steadily both in the water and in the steam space. When the abstraction is rapid [as with steam blowing off] the water maintains for a time a higher temperature than the steam space, with a corresponding generation of steam. When the pressure is lessened by actual cooling of the water, the steam only follows it gradually, and keeps up for a time a higher tension. The slight converse effect, at the moment of opening the feed, is accounted for by the additional consumption of steam due to the feed-pump and perhaps by a slight condensation of steam effected by the first entry of the cold water.

3. When the temperature and pressure are rising instead of falling, the steam tension will similarly appear in excess or in deficit of the theoretical pressure, according as the original cause of the rise is a checked consumption of steam or a more rapid generation. The first case is shown in the experiments when the engine was standing, the second on several occasions when it was in motion.

4. Whenever pressure is taken off water which is above the boiling point, a sudden generation of steam must ensue. This has been actually observed in the experiments to take place to the amount of ½ atmosphere under the ordinary conditions. In exceptional cases it might be much greater, especially when the large differences of pressure at different parts of the boiler [sometimes amounting to 30 lbs.] are taken into account. The sudden spring of the pressure gauge at the opening and shutting of the regulator indicates the violent effects which rapid changes of this kind would produce in a mass of vapor at high tension. The author thus considers himself to have shown that under a rare but not impossible combination of unfavorable circumstances, a sudden generation of steam might occur violent enough to burst, if not a new boiler, at any rate one deteriorated by long working. At the same time the much slighter effects of this kind produced by an injector as compared with a feed-pump should be noted as forming a substantial advantage on the side of the former.—*Engineering News.*

Naphthaline.

[London Journal of Gas Lighting, Oct. 16, 1877.]

The letter of Dr. Phelps, which we published in our last, induces us to make some remarks on M. Bremond's interesting paper on naphthaline. While admitting that the simple remedy he proposes for the naphthaline difficulty is no doubt effective, we cannot agree with his conclusions that naphthaline is sometimes produced by chemical changes which he supposes to take place in mains and pipes. Naphthaline is undoubtedly of pyrogenous origin—that is, it is formed in the retort. This fact is made sufficiently clear by M. Bremond himself. It is found in the tar condensed in the hydraulic main; it is found in larger quantities in that from the condenser proper. When not excessive in amount, the quantity that goes forward is, no doubt, held in vapory solution by the hydrocarbons, and we take it that the fact that the desiccation of gas prevents the deposition of naphthaline depends upon the circumstance, that the removal of this vapor leaves a larger proportion of the solvent vapors. It is inconceivable to us that the heat set free by the condensation of the aqueous vapor, and that produced by the friction of the gas in the pipes, can be sufficient to bring about chemical reactions which, until now, it has always been supposed require an intense heat for their initiation. The experiments of M. Berthelot are conclusive, we believe, on this point. The hydrocarbons from which naphthaline may be produced are exceedingly stable bodies, and nothing but a very high temperature will suffice for their decomposition. To establish his position, M. Bremond should put a mixture of the vapors of, say, styrolene and benzine, under the same conditions as obtain in the distribution of coal gas, and then carefully watch the result. He would watch, we think, a very long time before he found any naphthaline produced. The causes of the deposition of naphthaline are multifarious; foremost among them is a change of temperature. This accounts for its condensation with the tar. Next, perhaps, comes the influence of shock and friction; elbow joints especially favor its condensation. That it is rapidly deposited in pipes in which gas may be said to lie dormant, is a fact well known to every gas engineer. The reason for this is not very apparent, but it is possible that gas in a state of quiescence may deposit its naphthaline just as water deposits suspended mud.

The remedy which M. Bremond proposes, it will have been seen, is remarkably simple and inexpensive. It is only necessary to dry the gas by passing it through quick lime, which thereby becomes slaked, and is, when any condensed naphthaline has been removed, fit for use in the ordinary purifiers. To prevent the subsequent re-saturation of the gas with aqueous vapor is not so easy a matter. A thin layer of a fixed oil on the water of the gasholder tank, and the substitution of oil for water in the valves and syphons, would, no doubt, do much to obviate the evil.

That the illuminating power of the gas should be improved when aqueous vapor is removed, is a natural consequence; but there would, of course, be a diminished volume; the diminution however would be relatively small, and would scarcely affect the accounts of a gas company. The process certainly deserves a trial. The double desiccation proposed—that immediately after the purifiers, and again after the gas leaves the holders—would occasion much trouble; but, if oil were substituted for water in the valves and station meter, and the water in the tank covered with a layer of some fixed oil, the second desiccation, we think, might be dispensed wit. Theh re-saturation of the gas in the consumers meters we do not regard as of any consequence.

Electric Light.

An audacious attempt has been made to scare the Corporation of Birmingham with the apparition of the "Electric candle," the immediate application of which, on a large scale, in that borough a local daily paper considers possible. From what sources our contemporary obtained his information we cannot guess. Receiving, as we do, regularly, the American scientific and gas journals, and also all the journals devoted to gas on the Continent, we are bound to say that we have never heard, nor read, of the extensive applications of the electric light which our contemporary asserts to have been made, and to be still in operation. The information we receive goes to show that wherever the light has been tried it has turned out, more or less, a failure. We do not dispute the possibility of improvements, but we repeat a confident opinion that gas has nothing to fear from competition with the "electric candle."—*London Journal of Gas Lighting.*

[From London "Journal of Gas-Lighting."]

West of Scotland Association of Gas Managers.

[President's Address. Continued from page 8.]

Our worthy honorary member, Mr. Samuel Stewart, of Greenock, has also, at the request of your committee, prepared a paper on the construction of gas-works. From Mr. Stewart's ability and large experience in the construction and management of gas works both at home and abroad, we may expect a thoroughly practical and instructive paper.

Since our last meeting, the members of this Association will have had time to read and digest the reports and discussions on the Aitken and Young process of gas-making, and may desire to make further inquiries in this matter. Mr. Aitken has kindly agreed to open the discussion which I hope will be a sifting one. My own opinion is that the process is grounded on a thoroughly scientific basis, and that time is only required to ensure its adoption in all gas works.

Members will, as usual, have an opportunity of inquiries in reference to any subject in which they may be particularly interested, and in the general interchange of ideas.

I endeavored to get Mr. G. R. Hislop, of Paisley, to read at this meeting a paper on his patent for the revivification of spent gas lime. Owing to his experiments not being all completed, he could not comply. As lime is the only agent at present known to reduce the sulphur compounds to the standard of purity fixed by the Gas Referees of London, any process calculated to reduce its cost is specially important at this time, therefore I will venture a description of the process.

The calcining chambers are constructed in sets of four placed over a furnace, the first three being the calcining chambers at high heat. The fourth, or top one, has a capacity fully equal to the united capacity of the first three. In this chamber all the spent material is charged, and there it remains during the calcination of the contents of the chambers beneath, and after the latter have been discharged into the lower chambers through a port near the front of each, and which is covered with a suitable tile as the chambers are successively filled, commencing at the bottom one. The result of the process is that the spent lime is subjected to an intense heat, effected by a suitable arrangement of flues, through which all the gases from the furnace pass over the lime in close contact, disengaging the carbonic acid and other impurities. One man can attend to two sets of chambers, and revivify about 50 cwt. of lime per shift of 12 hours, producing about 25 cwt. of quick lime, and this at a cost of 10 cwt. of ordinary coke. In this way the same lime may be fouled and restored for 100 times or more; and as the best Irish lime shells cost, according to locality, from 20s. to 24s. per ton, it will at once be seen that a very great saving is effected. It should be stated also that no ridding is necessary, as in the case of lime from shells. And, again, all stones found amongst the lime are subsequently calcined in the process. When oxide of iron is employed, the spent lime is produced mostly in the state of carbonate, and is ready for recalcination immediately the purifier is thrown out of use; but when no oxide of iron is employed, the lime produced is largely charged with sulphur, as well as carbonic acid, and (while this lime may be restored from 10 to 20 times before it becomes exhausted by its combination with sulphur, forming sulphate of lime) the patentee proposes to overcome this difficulty by the utilization of the waste gases from the retort benches, steam boilers, or the chambers themselves, by drawing the carbonic acid gas from these sources by means of a rotary pump or exhauster, and after reduction to proper temperature, he forces it up through the fouled or sulphureted lime in the purifiers, when the carbonic acid has the effect of displacing the sulphur, which is again taken up by a supplementary oxide of iron purifier, and after the lime has been thus carbonated, it is removed to the calcining chambers. In this way the patentee expects to meet the requirements of all gas companies or corporations in respect of this hitherto waste product, which in several large works it has cost from 3d. to 9d. per ton to remove. From 25 to 30 cwt. of shells can be produced by this process from the stone per shift per man, and being entirely free from ashes or foreign matters, it will prove valuable for several chemical processes in which very pure lime is required.

My opinion is that where oxide of iron is used, and nothing derived from the waste lime, this process will effect a great saving. It has been in operation in Paisley gas works for the past twelve months, and, like all new inventions, has undergone considerable improvement. It is now being introduced into the Greenock Corporation gas works, where I do hope it will be found successful.

PURIFICATION OF FOUL LIME.

Parliament in the session of 1876, decided that the corporations of Scottish burghs can purchase the gas works within their boundary, by adopting a certain procedure. It is not for gas managers to enter into a public discussion on the benefits consumers derive from such a purchase, or *vice versa*. I am of opinion that the manager of a gas works that is threatened to be taken over by a corporation should maintain a strictly neutral policy, so that when the fight is over he will not have crippled himself by any statements unfavorable to the victor. I know managers who have made themselves uncomfortable by fighting the company's battle; hence my reason for bringing this before you. The majority of managers have yet to learn that there are decent corporations in our country, as well as companies.

FITTINGS.

Allow me, before closing my remarks, to briefly allude to a subject which I consider does not receive the attention it merits—viz., consumers gas-fittings. Almost all the complaints we hear of bad gas are due to this cause. We are doing a great injustice to ourselves, as well as to our consumers, in allowing gas-fitters to fit up houses with pipes at random. Our companies and corporations should prepare printed instructions, giving the sizes of pipe for the various distances and lights to be supplied, and grant licenses to competent gas-fitters who bind themselves, under a heavy penalty, to fit up gas-pipes according to these instructions; or adopt a rule to supply no person with gas whose gas-pipes do not comply with the instructions.

It is a singular fact that gentlemen well educated are often very ignorant in matters pertaining to coal gas. As an instance of this, I heard of a learned sheriff (anything but a joker) who suggested to a gas manager the propriety of sending the good gas to the good payers, and the bad gas to the bad payers. A paper at next meeting, on this subject, would be productive of much information.

The chairman and directors of the Helensburgh gas company deserve our best thanks for their kind invitation to visit their works. And now, gentlemen, I thank you for your patient hearing, and, with your kind forbearance and assistance, I will endeavor to carry out the programme, and bring the meeting to a successful termination.

Mr. M'Leod (Glasgow): I beg to move that we accord to the President our thanks for the very able and practical address which he has just delivered. There are points in it which have given me no inconsiderable gratification. The question as to the revivification of lime is one of the most striking that has been before our meetings for two or three years, and if Mr. Hislop is able to carry out his idea, he will confer an immense benefit on gas companies and gas corporations, and save them an enormous expenditure. Another point that struck me was the reference to gas-fittings. I think there is no point in regard to the details of gas distribution more pregnant than that there should be some improvement made in gas-fittings. I would refer more especially to the inadequacy of the pipes which the landlords are putting into those huge tenements which have been, and are being, erected in Glasgow. At present the gas-fittings are left in a great measure with the gas-fitter, whose main idea is to get everything done as cheaply as possible. If an Association like this were moving in the matter, we should have some direct contro over the size of pipes, and we should not hear so much complaint as we have heard periodically almost every winter. I observe now that the water commissioners in Glasgow have complete control over all sizes of water fittings, and if we had a similar power in regard to gas fittings, our towns, I have no doubt, would be much better lighted.

The motion was cordially received, and the President acknowledged the compliment.

Mr. Duncan Jeffrey (Kirkintilloch) then read the following paper:—

A TWELVEMONTH'S EXPERIENCE OF THE STEAM JET EXHAUSTER.

It is with considerable diffidence that I venture to address you upon the above subject; but, your committee having requested me to do so, and being (so far as I know) the only manager who has used the steam jet exhauster for any length of time exclusively for the manufacture of cannel gas, I considered I was in duty bound to comply, and it will afford me very much pleasure indeed to give you my experience, extending over the last twelvemonth.

The exhauster which I fitted up in my work is a Korting's, capable of passing from 3,000 to 12,000 cubic feet per hour, and is fitted, according to instructions received from the makers, on to the outlet of the condensers. This, as I shall afterwards point out, is not, in my opinion, the proper position for it.

At first I experienced considerable difficulty in getting the regulating gasholder and steam valve to act. Sometimes the exhaustion was not sufficient; at others, far too much; and this, in several cases, led to explosions. However, after some little experience, I succeeded in considerably modifying those defects, and it has since worked much more steadily, but we are by no means able yet to get a steady exhaust, any alterations in the making of gas or pressure of steam calling for personal attention to regulate the arrangement before a steady exhaust can be obtained. This is a mechanical defect, which must be remedied before it can be profitably introduced into works such as mine, where the make of gas is necessarily variable. There is also another defect which I have experienced in the steam jet exhauster—viz., that although the make of gas is very small, or even where no gas is making at all, the steam-jet keeps working, and a considerable amount of steam is used. These defects produce such a quantity of condensed steam-water as to a great extent to destroy the value of the ammoniacal liquor. Indeed, last year, I have had to give away for nothing a considerable quantity of my liquor.

It has been said that the steam-jet improves the illuminating power of the gas. This I have not found to be the case with me; indeed, I cannot well see how it could improve the illuminating power when placed where I have got it—viz., after the condensers, and therefore after the crude gases have been deprived of their tars and naphtha vapors. In my opinion, judging from experience, and from what we know of the Aitken and Young process, the proper place to apply the jet exhauster is where the gas leaves the hydraulic main, or as it enters the condensers, when the heating power of the steam would tend to diffuse through the gas the illuminating naphtha vapors. Although I have not found it to improve the illuminating power of my gas, I do not mean to say that others, where the make of gas is constant and large, have not got the gas improved, but where such a quantity of steam-water is brought into contact with the gas after condensation, as I have got, I do not see how there can be an improvement in the illuminating power.

After a twelvemonth's trial these are my personal experiences of the steam jet exhauster. Although it has not given me the satisfaction I could wish, and although I am of opinion, as at present constructed, it is not the best form of exhauster for works such as mine, yet I am satisfied that the steam-jet is a most convenient form of producing exhaustion; and in large works, more particularly where the coal contains a large quantity of ammonia, the steam jet exhauster might be very advantageously employed, and were those defects in its construction which I have just pointed out remedied, nothing could equal it as a means of exhaustion.

The President: We are all, I am sure, delighted with this paper. It opens up a very nice field. So far as Mr. Jeffrey's experience is concerned, the steam-jet exhauster does not suit the size of his works but as I know that some of the gentlemen present have given the subject great attention, I trust we may have the benefit of their experience.

Mr. Young (Clippens): As I have had some little experience in the employment of steam-jet exhausters for exhausting gas, though not for illuminating purposes, I may be permitted to make a few remarks upon this paper. I am quite at one with Mr. Jeffrey in believing that the jet, as at present constructed, although a beautiful arrangement, is yet a defective instrument, and not suited to exhaust gas for illuminating purposes. In the works where I am engaged, we employ a steam-jet exhauster to exhaust our gas, and also with the secondary object of precipitating our oily vapors and absorbing ammonia. Our object is to deprive the gases of as much of their naphtha as possible, and we find that the steam-jet effects this to a considerable extent. I may mention that when we erected an apparatus for the extraction of the volatile hydrocarbons from our waste gases we found some difficulty arising from the use of the steam-jet keeping the gas above the temperature which we desired, and it became a matter either of employing extra condensing power, or employing some other means of exhaustion. I thought of employing the ordinary fan, and I tried it. In doing so I found at once a very considerable decrease in our oily products. At the same time those vapors which would have been precipitated found their way forward to the arrangement for the condensation of gasoline, and were there recovered. This points out conclusively that when a steam-jet has been put into gases after being condensed, the tendency is to carry down some of the hydrocarbon vapors along with the precipitated condensed watery vapors. I am also at one with Mr. Jeffrey in believing that the steam would have an opposite effect if it were introduced at the point where the gas leaves the hydraulic main, because there the steam would act the part of gas in keeping in diffusion the hydrocarbons until the denser tars were settled out. This morning I had a conversation with a gentleman who, for this purpose, has introduced steam into his condensers, and he says he finds great advantage indeed by putting the steam in at the beginning of the condensing arrangement, because it tends to precipitate the tarry product, and keeps the naphtha vapors in suspension until the gases are removed from the absorbing influence of the tars. The mechanical defects referred to by Mr. Jeffrey are only mechanical defects, and I believe they can be overcome. When this exhauster was first brought under the notice of the gas fraternity, as a novelty in the exhaustion of gas, I pointed out to the inventor that it was not a novelty for that object, and that it had been long in use at oil works in Scotland for that identical purpose. I pointed out that the instrument which had been constructed was deficient, that it was the impact, if I may so speak, of the steam in the surrounding gases which induced the exhaustion, and that the greater the velocity with which the steam issued and came in contact with the gas to which it was applied, the greater was its exhausting power; and therefore that it was quite evident that the steam should issue always at its greatest possible velocity. I also pointed out that the best way for accomplishing this was to have an arrangement by which the steam could be regulated by a spindle working into the pressure orifice. Further, I pointed out that there was a defect in keeping the orifice through which the steam had to drive the gas always of one particular size. It is immaterial what quantity of gas is making, the steam must be constantly blowing through that orifice. Although no gas was being made, as much steam must be passing through as will overcome the back resistance of the pressure induced by the weight of the gasholder, etc. I pointed out that an arrangement could be made that as the gas lessened in quantity the multiple conical orifices could be brought together until they were closed when no gas was passing through, or adjusted to the quantity being made. That, in my opinion, would be a perfect arrangement, and I think ultimately there will be such an instrument produced.

Mr. Mitchell (Coatbridge): The question on which Mr. Young has just spoken is, to my mind, one of the most important to Scotch gas managers—that is, the extra condensation of the volatile hydrocarbons suspended in the gas. I can bear out Mr. Young in his statement regarding the increased condensation by the steam-jet exhauster, and that, in my opinion, is one of the principal defects of the steam-jet exhauster for Scotch gases.

Mr. Young: I may explain that Mr. Mitchell was my assistant at the time these experiments were made in regard to the steam jet, and that he had charge of the crude department in the works. The manager in each department has to give an account of the material that is put into his hands. He must show a certain amount of produce from a certain amount of crude material; and Mr. Mitchell had to suffer from the loss in the yield of the oils by the substitution of the fan for the steam-jet. We make it a point to have regular dips of the oil receivers, and his dips immediately came down on the cessation of the use of the steam jet.

Mr. Robson (Selkirk); Last winter I found that the ammonia crystallized in some of the underground pipes, and I could not remove it until I got a steamer. Now, this day fortnight I was about five hours blowing steam, at a pressure of 45 lbs., into the pipes, and I thought I would have destroyed the gas; but the gas never had been better—the illuminating power had been increased.

Mr. Young: I can quite understand that. In the first place, where the ammonia would crystallize as a carbonate and hydrosulphite, you would also have a deposit of naphtha vapors.

Mr. Robson: Yes.

Mr. Young: Then the moment you introduced steam you would volatilize these naphtha vapors, throw them into the gas, and increase its illuminating power. That is quite evident.

The President But there would be a limit to that?

Mr. Young: As soon as you dried them up, you would just be dried up.

Mr. Sugg: I do not care to venture an opinion on this subject, because in London the steam-jet exhauster has not been so well tried. There are conflicting opinions relating to it. In some places in London the steam-jet has been shifted to various places from the hydraulic main to the last purifier, and it is said that at this latter place there will be found to be a separate process of condensation. That has been tried, but I do not know whether it has succeeded. There are many difficulties in the way, one being whether you can seal the purifiers and go on with exhaustion on the last purifier. That is being tried, but whether or not it will be successful we have not as yet learned. Curiously enough, the effect of this experiment is to produce naphthaline, in some cases, and, with the steam-jet, there has been greater trouble with the naphthaline than without it. Sometimes, however, naphthaline is not produced, although the steam-jet is used, and the works are in every respect alike. Generally speaking, in Germany the experiment has not been considered successful, while in some parts of France it has had considerable success. I think if an improvement could be made, so that the steam should cease to rush through the pipes when no gas is being worked, it would be of great utility, and this might modify the bad effects of the steam-jet in places where they are complaining of it. The arrangement ought to be that, with the increase in the quantity of gas, the velocity of the steam ought to increase, and where there is little gas being made, there ought to be little steam. With regard to the condensation, I do not think that ought to give much trouble. Professor Tyndall has shown by experiments, that the hydrocarbons of gas have an extraordinary power of absorbing heat, and they get rid of it as quickly as they absorb it. Hydrogen, oxygen, and nitrogen, according to these experiments, do not absorb heat as rapidly as the hydrocarbons of gas, and, therefore, it is probable that they would absorb the heat from the steam, and when they got into a cool place they would let the heat go. Consequently, I think there ought to be no more difficulty in condensing with the steam-jet than without it. I have seen works at Woolwich where such condensers are used, and although they are small in comparison with the works, they perfectly condense all the steam put through them in a short space of time. I cannot say much more about the steam-jet, because, although there are several experiments being made, no definite results have been arrived at, and it is difficult to say whether they will be successful or not.

Mr. Mitchell: Did Mr. Jeffrey find any difference in the illuminating power after working with the steam-jet exhauster than before?

Mr. Jeffrey: I found no advantage whatever, and as the steam-jet exhauster is placed I do not see that it can be of any advantage.

Mr. Mitchell: I was asking if it increased the illuminating power, because the position it occupied in your works was different from any experiment that I tried with it. I worked with it immediately after the gas left a supplementary condenser, and before it went into a final condenser, and it was then I found the advantage in increased condensation.

Mr. Jeffrey: At first I thought it was of some little advantage, but, after paying particular attention, I came to the conclusion that it was of no advantage. I thought, when it reduced the liquor in the scrubber, it would also reduce the illuminating power.

The President: From your reading of the photometer you found that your illuminating power was reduced?

Mr. Jeffrey: Yes.

A vote of thanks to Mr. Jeffrey brought the discussion to a close.

At this stage, Mr. Lennox, one of the directors of the Helensburgh gas company, said: On behalf of the chairman and other directors of the company, I have to welcome you to Helensburgh. We have also Mr. Chairman to thank you for your practical and exhaustive speech. I think it is the duty of directors of gas works to encourage such meetings. On this point there ought to be the greatest unanimity between gas managers and directors. Mr. Smith, my brother director, who is present, I have no doubt can reciprocate my feelings in that matter. I have now to invite you to visit our gas works.

The President: On behalf of the Association I, have to thank you, the directors of the Helensburgh gas company, for your kindness, and to intimate that after the reading of the next paper, we will take advantage of your kind offer, and visit the works.

Mr. William Sugg (London) read the following paper on

SUGG'S ILLUMINATING POWER METER.

In February, 1876, I read before the Institution of Civil Engineers, in London, a paper upon the Illuminating Power Meter. I had then necessarily to review, in as rapid a manner as possible, all that had been done in the way of gas-testing, in so far as it related to the standard burner. But as I have now the pleasure of addressing an audience entirely composed of gas engineers, who are thoroughly acquainted with all these practical details of gas-testing. I intend, in

this short paper, to confine myself more to the instrument itself than to the general system of gas-testing. I must, however; commence with some remarks explanatory of the origin of this instrument. They are simply these. As far back as 1868, I was engaged, in collaboration with Mr. Kirkham, then engineer to the Imperial Gas-Light and Coke Company, in a series of experiments, with a view to establish the relation ship (as regards its indication of the illuminating power of gas) between the Lowe Jet Photometer and the systems adopted for the verification of illuminating power in England and France, so that we might construct a table for the use of engineers working with the Lowe Jet Photometer. We then tried both the Carcel lamp, burning colza oil, and the parliamentary sperm candles, manufactured by the best makers. In the performance of these experiments we discovered that the sperm candle was an extremely variable kind of standard, and as it was then, so it is now. Of this I shall offer you what I think is a convincing proof shortly. But as our work was to lay down a table of comparison between the illuminating power of gas, as estimated by the aid of sperm candles, and the jet photometer, we devised a photometer in the form of a cross, at which four operators could work simultaneously, comparing the same gas-flame with different candles; and so, by making a large number of experiments, we arrived at a tolerably accurate estimate of the illuminating power evolved by the combustion of five cubic feet of 14 to 18 candle gas in Argand burners.

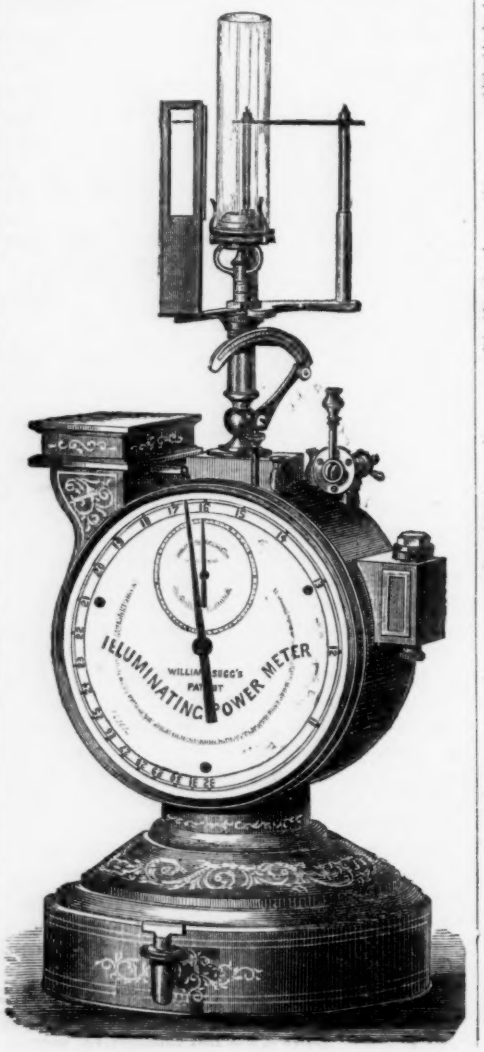
But the greatest difficulty we had to contend with was the burner. We found that, in order to arrive at an accurate knowledge of gases containing different proportions of luminiferous hydrocarbons, it would be necessary to have as many different standard burners as there were different qualities or gas. Now, the only accepted standard burner we possessed at that time was the Sugg-Letheby, for 14-candle gas. Although we improvised other burners for the higher and lower qualities, which were probably on a par with the Letheby burner, yet we saw clearly that, to arrive at anything like accuracy, the whole question of burners must be worked out. I undertook that work, and I have now a set of standard burners which will burn gas of from 12 to 45 candles illuminating power. It was then a generally received opinion that the greater the quantity of gas burned in one burner the greater would be the proportion between the quantity of gas consumed and the light obtained from such quantity. Thus, for example, if from a burner consuming 2½ feet of gas the light of four candles only could be obtained, then from the combustion of five cubic feet a light of from 12 to 13 candle could be produced with the same quality of gas. You will at once perceive that these ideas were mostly founded upon the combustion of gases of a low illuminating power, and that rich cannel gases had not been taken into account at all. If they had, it would have been found that with such burners as those usually employed in testing gases of low illuminating power, the example given above would have been sometimes very nearly reversed.

There is every reason to suppose that practically every quality and quantity of gas can be burned to a proportionately good effect, if the supply of oxygen from the air is proportioned to the quantity of light-giving hydrocarbons in the gas. I have made ten different sizes of the "London" Argand burner. Six of these sizes give 3·4 candles light for every cubic foot of gas consumed, with 16-candle gas. The other four, which are of a larger and slightly different construction, give from 3·6 to 3·8 candles per cubic foot of gas consumed, with the same quantity of gas. But if we change the quality of gas, and supply them with 20 or 30 candle gas, then the proportion of light to the cubic foot of gas consumed will be changed slightly. The smallest size will be improved, and the largest of the first six sizes will be a trifle lower. The greatest improvement, however, will take place with these center-jet Argand burners and the double and treble flame Argand burners, because the greater quantity of oxygen supplied to them (rather in excess for the poor gas) will enable the richer gas to attain to a higher degree of incandescence.

Now, you will see from this that if we are to burn five cubic feet per hour of every quality of gas, as decreed by Act of Parliament, we shall require as many different standard burners as there are different qualities of gas. Therefore, for the practical gas-maker, who has to produce gas from an endless variety of coals, it is above all things important to have at hand an instrument which will fairly judge every different sample, without giving him the trouble of making a series of preliminary experiments to find out the most suitable burner for consuming the gas when he has made it. The adoption of a standard burner by mutual agreement between the gas company and the consumer, for verifying the illuminating power of the gas supplied by the one and accepted by the other, implies a knowledge beforehand, on the part of the official tester, of the illuminating power—within a candle or so—of the gas he is about to test. Even then difficulties constantly arise, from the fact that, from various causes, there are variations in the illuminating power of the gas supplied, and five feet of gas at one time will burn properly in the standard burner, whilst at another it smokes or is over-oxidized.

If an engineer tries coal in this manner, it is certain that the coal which comes out the best must be that which suits the standard burner, and perhaps not that which is really the best to produce the supply of gas from.

I am, however, not going to say that the official standard burner and photometer will not find out which is the best coal if a sufficient number of experiments be made to cover the errors of the candles and burner; on the contrary. But the duties of an engineer do not frequently leave him sufficient time to carry out such elaborate experiments, and the means he employs must necessarily be rapid, and at the same time *certain*.



Such a means is provided by the Illuminating Power Meter. A few minutes will show, with as great accuracy, the illuminating value of the gas, as a long day of experiment with candles.

As a proof of this, I cite the following example:—On the 31st of May last I made, by the kind permission of Mr. M'Minn, the engineer of The Gas Light and Coke Company's station at Fulham, a day's experiment, with four different kinds of parliamentary sperm candles from the best makers in London. Eighteen tests for illuminating power were made by four different operators at the cross photometer upon the same gas. A different pair of candles was used at every test. The highest result was 17·37, and the lowest 13·92 candles. Yet all these were best parliamentary sperm candles!

At the end of the day, as a last experiment, the Illuminating Power Meter was connected to the photometer we had been using, and its indications observed. It gave us the illuminating power 16·20 candles. The average of the whole of our tests was 15·715 candles.

THE GAS-LIGHT AND COKE COMPANY, FULHAM STATION, MAY 31ST, 1877.

Experiments to ascertain the variation in the illuminating value of candles by different makers; cross photometer used; four operators; same quality of gas all through the experiments; consumption of gas, 5·05 cubic feet per hour; temperature, 65°; barometer, 29·6; jet photometer, ·62 = 16·47; Illuminating Power Meter, 16·20 candles.

MILLER.

Operator.	Consumption of Sperm.		Illuminating Power of Gas in Sperm Candles.
	Grains in 10 Minutes.	Grains in 1 Hour.	
A. C. M'Minn	37·95	113·85	16·29
A. C. M'Minn	37·00	111·00	17·37
W. Sugg	40·00	120·00	15·04
H. Jago	37·59	112·77	16·52
W. H. Edinger	38·09	114·27	15·60
Average	38·126	114·378	16·164
Greatest difference	3·000	9·000	2·33

BRECKNELL AND TURNER.

W. H. Edinger	40·32	120·96	15·48
A. C. M'Minn	40·20	120·60	16·00
W. Sugg	38·91	116·73	15·73
H. Jago	37·52	112·56	16·79
Average	39·23¾	117·71¼	16·00
Greatest difference	2·68	8·1	1·21

BARCLAY.

H. Jago	45·45	136·35	15·14
W. H. Edinger	45·92	137·76	14·64
A. C. M'Minn	42·68	128·04	15·10
W. Sugg	45·14	135·42	13·92
Average	44·79¾	134·39¼	14·7
Greatest difference	3·24	9·72	1·27

FIELD.

W. Sugg	39·29	117·87	15·89
W. Sugg	42·64	127·92	15·24
H. Jago	37·66	112·98	16·06
W. H. Edinger	39·37	118·11	14·79
A. C. M'Minn	36·93	110·79	17·26
Average	30·178	117·534	15·848
Greatest difference	5·71	17·13	2·47

Average of average, 40·33475 grains in ten minutes; 121·004¼ grains per hour: 15·678 candles illuminating power.

Average of differences, 3·03 grains in ten minutes

8·73 grains per hour; 1·25 candle illuminating power.

Average of illuminating power, 15·715 candles.

In the month of June last I tested the gas supplied in one of the *arrondissements* of Paris with an Illuminating Power Meter similar to this, but scaled off according to the French system of testing the companies gas with a Carcel lamp. The calculations for this scale had all been made in London, yet the indications of the meter accorded within a fraction with the results obtained by the official gas examiners.

The gas made at one works in Liverpool has also been tested for some time with the Illuminating Power Meter, and its indications agreed with those obtained from King's photometer, and comparisons with candles.

And so at London and other places different in illuminating power, and tested by the official standards, yet the average of the tests agreed.

The principle upon which it is constructed is that the richer the gas the less the quantity of it that is required to develop a flame of three inches in height, the same burner and chimney being used for all gases alike.

I at one time thought that the light from the standard flame would be the same from all qualities of gas, but a long series of experiments with higher qualities of gases showed that, when the same chimney is used always, there is also an increase in the light given from the 3-inch flame as the gas becomes richer in hydrocarbons. This appears to be due to the employment of the same burner and chimney for every quality of gas. As I have before said, to develop light from different qualities of gas in direct proportions, per cubic foot, to the quantity of gas consumed, a different burner and chimney must be employed for every quality of gas, even although the flame is kept constantly at one height.

But in the Illuminating Power Meter, as now arranged, the increase in the light given from the three inch flame, when the same chimney is used, and the burner is supplied with different qualities of gas, does not affect the result of the observation, and for this reason:

The rate of increrse in the light having been once calculated and verified by actual experiments, the dial is corrected for that increase, and so the readings are made accurate.

The gas to be tried is admitted into the inlet of the meter, which is at the back.

A "London" Argand burner, provided with a well-made cylindrical chimney, is fixed, by means of a ground swivel joint, on the top of a pillar screwed on to a hollow rectangular base, which is firmly soldered to the outer case of an experimental meter. This base has no communication with the inside of the meter-case. That part of the pillar between the top of the base and the burner forms a cock, the gas-way of which is not drilled in the usual manner, but is slotted across the plug. The sides of this gas-way being parallel to each other, it follows that, unlike those cocks fitted with round-way plugs, the cock opens when the lever is turned by regular gradations until it is full open. A quadrant, divided into forty-five equal divisions, attached to the cock, enables the operator to regulate the flow of the gas to any required rate with rapidity and precision. Above the quadrant a sighting-frame is fixed, having two upright pillars, crossed by a flat bar at one end, and at the opposite end a frame fitted with blue glass. A scratch is made across the glass exactly three inches above the solid part of the frame. The bottom of the opening, the top of the burner, and the termination of the thick part of the back columns are all on the same level. The scratch on the glass and the bar which crosses the back pillars are also on the same level, and parallel to the three lower points just mentioned. By these arrangements the operator is enabled to adjust the height of the flame to the level of the scratch and the back bar.

It may be observed, in passing, that if some points n the flame pass the line by about one-eighth of an nch, it will make but a very slight difierence to the result. There will always be small points which will look like flame, but which are only heated air. A few minutes practice will suffice to enable any one, without previous knowledge of the instrument, to adjust the height of the flame.

On the left side of the hollow base on which the pillar stands is a tube which connects the base to the outlet of a double governor. The square box on the left of the meter is the governor, which serves to maintain uniformity of pressure during the time the instrument is in use. This governor is adjusted so as to give pressure enough to make the flame tail over the chimney when the regulating cock is full open.

On the right of the hollow base is fixed a two way cock, with a lever ending in a knob fixed to its plug. The cock is quarter stopped, so that when it is turned in one direction as far as the stop, it is full open, and in communication with the inside of the meter, which is full of measured gas. In this position the measured gas passes through the length of the plug of the cock, and by means of a tube fixed to the end of the cock at one end, and to the inlet of the double governor at the other, it finds its way through the governor to the hollow base, and finally to the burner. While the gas is passing to the burner by this route, the measuring-drum of the meter revolves; but if the lever of the cock is turned in the opposite direction until it meets the stop, another route is opened for the passage of the gas. It then passes directly from the inlet of the meter without passing into the measuring-drum, through the length of the plug of the cock, and out by the same tube as before to the inlet of the governor, thence to find its way to the hollow base and the burner. In one position of the lever the measuring drum of the meter is at rest, and the gas is unmeasured. The governor having been properly adjusted, and the meter having from 8 10ths to one inch of pressure at its inlet the change in the position of the lever will not influence the height of the flame.

The index hand is attached to the arbor of the measuring-drum, and therefore revolves with it, both making a revolution in the same time. The dial is divided into a number of divisions, corresponding with the illuminating power in average parliamentary standard sperm candles, of the different qualities of gas which will give a flame of three inches in height. Thus, if the meter is supplied with 16-candle gas, and the flame is maintained at three inches, the index-hand will make one complete revolution in one minute. If the meter is supplied with 12 candle gas, and the flame maintained at the 3-inch line, the hand will make one revolution and a part of another, arriving at the figure 12 in one minute. With 20-candle gas it will make less than a complete revolution in one minute, and arrive at 20. The instrument is provided with a very accurate and strong minute clock, with one pointer-hand, which makes a complete circuit of the small dial in one minute. This dial is divided into sixty equal divisions, representing seconds.

On the right of the cylinder which forms the outside case of the meter is the water-line gauge, fitted with back and front glasses. At the correct water-line these glasses are stretched across. On the top of the water-gauge is a large nut, which can be unscrewed when it is required to fill the meter or clean the gauge-glasses. The plug at the lower part of the gauge is for the purpose of running out the water, if there is too much in the meter.

In the base of the meter is a cock for the purpose of emptying all the water out of it, when it is requisite to do so. The meter should never be turned upside down for the purpose of emptying, or some water will get into the governor and connections, and probably cause trouble. For the purpose of filling the meter a solution of one part of good glycerine, free from acid, in three parts of distilled water, should be used.

The mode of putting it into operation is very simple. Having filled the meter up to the water-line scratched on the glass, connect it to the gas supply with a piece of metal tube. The inlet is a ground union joint, fixed in the center of the back of the instrument. Turn the lever so as to make the gas pass through the measuring drum, and let it get rid of all the air or other kind of gas in it. Light the burner, and adjust the flame to three inches in height. Then, when the large hand arrives at 16, change the position of the lever, so as to make the gas pass to the burner, without going through the measuring-drum. The large hand will then stop at 16. Wind up the clock by means of the *remontoir* on the top of the meter, just in the rear of the dial-ring. Start the clock by moving the slide which is on the left of the meter, close to the governor. Then, when the hand of the clock is passing any one of the divisions of the minute, change the position of the lever of the bye-pass, so as to make the gas pass through the meter. When the minute hand has made one complete revolution, stop the meter by means of the lever, in the manner before described, and read off the illuminating power. The minute clock should not be stopped either before or after the observation, unless it is desired to put the clock entirely at rest.

It will not have escaped your observation that the Illuminating Power Meter is a combination as it were, of the Lowe Jet Photometer, the well-known duration test of Dr. Fife, and the burner part of the parliamentary test.

The meter at present before you is not precisely the kind which I have made for gases of high illuminting power produced from cannel coals. This commences at 12 candles, a standard of illuminating power which is, I think, not often seen in Scotland. The one I have constructed for Mr. King, of Liverpool, and which he has adopted for his purpose has a different dial. The standard point on the top of the dial is 20 candles instead of 16.

But, nevertheless, the scale of this meter, although fine towards the high numbers, is just as easily read as in those places where it is wider, because with the richer gases the pointer moves slower.

The Illuminating Power Meter will, I am sure, be found very useful to the engineer, but I do not think it will ever, or, indeed, can ever, he adopted as a parliamentary standard.

For this purpose I believe we must have a natural product, such as sperm oil, which is also used for producing artificial light. This has a commercial value not very fluctuating, and gas can be measured with it both for illuminating power and price.

My knowledge of petroleum oil—not very great, perhaps—does not lead me to anticipate any good results as a standard test for gas. It is a congeries of oils of different specific gravities and different illuminating powers, and it does seem difficult—I do not say impossible—to make use of such a variable material as a standard. It seems to me to resemble a standard yard measure made of india-rubber. Candles, since the days of George Lowe, have been found by all experimentalists to be very uncertain as a standard. I presume if sperm or wax candles had been found reliable, Dr. Fife would not have invented the duration test; yet I must say that it does astonish me to read in the JOURNAL OF GAS LIGHTING of the partiality for sperm candles as a standard, expressed occasionally by different writers. Dr. Letheby stated, at the Institution of Civil Engineers, in 1876, that candles had been, and were, liable to constant variations, from the manner in which the wicks were made, and from the different qualities of wax used to break the grain, as it is technically called—that is to say, prevent the grain from crystalizing.

One of the present Gas Referees, Mr. Vernon Harcourt, says the same thing, and has proposed another standard, viz., pentane mixed with atmospheric air. I can tell you also that, of the four different kinds of parliamantary sperm candles, tested by myself and others at Fulham in May last, one maker's candles were mixed with paraffin or petroleum, and it was those candles which brought down the average of the other three kinds, so that the grand average of all the experiments showed a little lower than the reading obtained from the Illuminating Power Meter.

It is beginning to be felt that something must be done to obtain a more scientifically accurate test than candles. Gas engineers cannot, wtth the increasing demands made upon them, be for ever at the mercy of the sperm candle. The late Dr. Letheby. whose loss the gas world much regrets, was of the same opinion as myself—that every quality of gas shauld be tested by one standard burner, the quantity consumed varying in inverse ratio with the quality. This opinion is shared by Dr. Pole, one of the present Gas Referees for London, and, I believe, by his colleague, Mr. Vernon Harcourt, and by other eminent scientific chemists and gas engineers.

The constant standard quality of five cubic feet for every gas is practically impossible, and only leads to great inconvenience, instead of promoting a just appreciation of illuminating power.

The consideration of these difficulties naturally lead to the invention of the instrument before you. I think it will be found that not only will this instrument be an excellent guide for the engineer, but that if it is used in comparison with, say, the candles till a better standard is found, and a very useful and reliable verification apparatus will be obtained.

The manner in which I propose to use it as a verifying instrument is as follows: The Illuminating Power Meter, with its burner and chimney. occupies one end of the photometer; at the other is placed a delicate balance, carrying two pieces of candle—a candle cut in half at the middle, and burned, one end towards the butt, and the other towards the point. By this mode the different specific gravities of each part of the candle are made to equalize each other. The candles are allowed to burn themselves into their normal state of burning, aed are left slightly heavier than the counterbalance. The flame of the Argand burner is to be regulated (irrespective of quantity consumed) to a height of 3 inches. The King's pressure-gauge is to be put in communication with the foot of the standard burner, so that the slightest variation in pressure may be observed by the operator. The pressure required to give a 3 inch flame is to be noted by the operator. Then, when the candle balance is in equilibrium, the candle minute clock is to be started, and the operator drops a 40-grain weight into the candle scale.

He takes nine observations, one at the expiration of each minute. At the ninth minute he leaves the disc, and watches the candle balance; as it comes again into equilibrium he stops the minute clock, and notes the number of minutes and hundredths of a minute the candles have taken to burn the 40 grains of sperm.

He then consults a table, which has been prepared by Mr. T. W Keates, the consulting chemist to the Metropolitan Board of Works. This tells him at a glance how many grains of sperm at such a rate of consumption the candles would have burned in ten minutes.

The operator has then to take his tenth observation. (The candles are not blown out.) He is to add up these observations, and multiply the mean of them by the number of grains consumed by the candles in ten minutes, divide the product by two, and the result will be the illuminating power of the gas consumed by the standard burner. Then he has to take one observation of a minute with the Illuminating Power Meter, and note the result. This observation will give him at the same time (the dial being properly divided into cubic feet and parts of cubic feet) the quantity of gas consumed by the burner, and the illuminating power of the gas at the standard rate of five cubic feet per hour.

The illuminating power of the gas, as determined in the first sum, has then to be multiplied by five, and divided by the quantity consumed by the standard burner per hour.

The result will be the illuminating power of the gas at the parliamentary rates of consumption of 120 grains for the candle, and five cubic feet per hour of the gas.

The check test of the Illuminating Power Meter will always show any variation in the standard of comparison, whether it be candles, oil, or aay other suitable standard. Of course, if the present—as I think bad—sysiem of using five cubic feet for every test is abandoned, this experiment will be very simple indeed. The complication is due entirely to the extra calculation involved in bringing the results up to the standard of five cubic feet. In Scotland it will be next to impossible to retain this standard, because the gas is too rich generally to be tried with a greaetr quantity than three feet, or three and a half feet at the outside. Therefore, the dial of the Illuminating Power Meter may be trusted to do the calculation, if it be required to know what such gas as that tested would give per five cubic feet of gas per hour.

In conclusion, I thank you very much for the great attention you have accorded to this paper, and I hope that what I have said may be found useful to you in assisting you to a correct estimation of the result of your labors in the production of illuminating gases. I am much pleased at the bonor you have conferred upon me this morning, and shall at all times be glad to do what I can towards our mutual improvement in the common object we have in view, viz., the production of artificial light from coal gas.

[To be Continued.]

The Telephone.

BY PROFESSOR A. GRAHAM BELL.

[From the "Journal of the Society of Arts," Nov. 30.]

[Concluded from page 12.]

The effect of reversing an undulatory current is to strengthen and weaken the magnet, and the result is that the plate is attracted in a varying manner, and the plate at the receiving end vibrates in a similar manner to the one at the transmitting end, and so a similar sound is produced. You, therefore, have the voice of the speaker converted into electricity here, and at the other end of the circuit you have the current of electricity re-converted into sound. No voltaic battery is used in this form—nothing but the magnet itself. I may here state one defect of the current. It frequently happens that, for practical purposes, the current is sufficiently undulatory to produce, at the other end the effect of articulate speech, but the current produced in the coil is not strictly proportional to the velocity of the motion of the plate, as was pointed out to me by my friend Prof. Cross, of the Institute of Technology at Boston, for there is another effect produced depending on the proximity of the iron plate to the pole of the magnet. If it be moved with a certain velocity, and the plate is very near the pole of the magnet, the effect produced would be very much greater than if it were farther away, so that you have the approximation or the separation of the two affecting the result. In fact when the plate vibrates towards the pole, the current produced is too strong, and when it goes from the pole of the magnet it is too weak. So that the effect is not strictly an undulatory current. If the amplitude of the vibration of the plate is very great the defect is magnified, but if it is lessened the effect more nearly approximates to the undulatory character. Hence the curious effect, that soft speaking is much more distinct than loud speaking If you shout or roar into the telephone, you have the sound produced at the other end very loudly; but a discriminating ear will recognise that the articulation is not so distinct as when you speak more softly into the instrument. However, theory shows one way in which the defect can be remedied. Suppose we have alternate impulses going along the wire, and that, when the plate comes towards the magnet, we have a positive current produced, and when it goes away a negative current. The coil may be so arranged that when the positive current traverses it, the magnet will be strengthened, and it will then attract the plate with greater force; and thus, when the first plate approaches the magnet, the other will do the same, and thus the defect will be magnified. But we may also arrange the coil so that, when the first plate approaches the magnet, the other will recede from it, and thus the effect I have spoken of will be neutralized.

This leads me to a very curious point in the use of the telephone, viz., that you can control the phase of a vibration by specially arranging the coil. You can take two telephones and arrange them so that, while the same person makes a musical tone into the receiving instrument, the phases of vibration of the plates shall be identical or opposed. Sir William Thomson, a few days ago, made an experiment of this kind with me in Glasgow, and we found that the telephone is a beautiful instrument for illustrating the interference of sound. If you arrange the instruments so that you have the phase of vibration the same, and then place your ear to the instrument, you can perceive the sound approximately doubled in intensity; but arrange them so that the phases are opposite, and there is a "dead spot,"—silence is produced at one point. I never heard interference of sound so beautifully illustrated as in that experiment, and there is no doubt that many uses can be made of the instrument in acoustics, from the fact of our being able to control precisely the relative phases of two vibrating bodies. The experiments made with this telephone a few days ago by Sir W. Thomson have demonstrated the fact of an interference in the perception of sound. For instance, take two instruments, one vibrating in a certain phase, and the other in a phase nearly, but not quite, the same. Place one to one ear, you perceive the sound on that ear alone. Place the other to the other ear and you perceive it on that ear alone. Place them to both ears at once, and you can arrange the phases of vibration so as to make both tympanic membranes act at the same time, or vibrate in a different manner; and there is a curious difference in the perception of the sound. It cannot be described, but it is something of this kind. You place the instrument to each ear in that way; where the phases are identical, you have a single sound, and you may localise the sound say on the surface of the two ears, but when the phases of the vibrating plates are reversed, the locality of the perception seems to change, and it seems as if you heard the sound at the back of the head, instead of at the surface of the ear. Moreover, if you take two distinct circuits, and have one telephone on one circuit and one on the other, and have a musical tone produced from one telephone, which is almost, but not quite in unison with that produced from the other, you have beats.

We know that if two organ-pipes, for instance, were vibrating in this room, the pitches of which were adjusted in that way, we should be cognisant of beats, illustrating the interference of sounds of that sort. Sir William Thomson writes me that he has shown that the same effect is produced in the sensation of sound. for placing one plate to one ear and the other plate to the other ear, so that each ear perceived only one sound, the same effect of beats was produced, showing very conclusively the interference in the sensation of sound itself.

The next illustration shows the way in which the telephone can be employed for the actual purpose of conversing at a distance. It is preferable to employ for this purpose two telephones, one in front of the mouth, and the other at the ear, for it has been found that when one telephone alone is employed, it constantly happens that persons separated by miles of distance speak at the same time or listen at the same time, and by placing one telephone to the ear and the other to the mouth, conversation at once becomes practicable.

Of course the question will probably arise how far can it be possible to use the instruments? That as yet we do not know. The limit has not been found. In laboratory experiments no difficulty has been found in using an apparatus of this construction through a circuit equivalent to 6000 miles. In this instrument we have a powerful compound permanent magnet. The longest actual wire I have been able to experiment upon has been 258 miles in length, and no difficulty was experienced so long as the other parallel wires were not in operation. The instru-

ment is wonderfully sensitive to inductive influences, and when you use a wire upon the poles with other wires you have the benefit of the other messages that are passing along the other wires on the telephone. However, means have been discovered very recently by which the inductive influence of other wires can be overcome and neutralized, so that I hope we may have the instrument in use upon circuits of all lengths. I do not know that there are any other points that I should like to mention to you to-night, excepting a new application that is shown here to a diving apparatus. Inside the diver's helmet you place a telephone of convenient structure, and in the place of using a separate telegraph wire, we use the wire that is coiled up inside the breathing pipe. In every breathing pipe of course there must be a coil of wire, in order to withstand the pressure of the water, and that wire we find can be used for the purposes of the telephone, so that the wire inside this pipe is connected with the telephone inside the diver's helmet, and the earth connection is simply made by attaching the other wirs to the helmet itself which is in contact, outside, with the salt water. I had the pleasure of trying to converse with a diver yesterday, with perfect success, at Messrs. Siebe & Gorman's in a tank. He heard every word I said, and I was able to understand every word he said; and when I told him to come up, by word of mouth he obeyed me. I do not know that there are any other points of interest to you, but I shall be very happy to attempt to answer any questions that may be put.

The Liquefaction of Oxygen.

Six gases, say the textbooks of elementary chemistry, have never been liquefied, though it can scarcely be doubted that their liquefaction would be effected could we apply an intense degree of cold and pressure combined. These gases are hydrogen, marsh gas, nitrogen, oxygen, carbonic oxide, and nitric dioxide.

We shall be able for the future to test the date of the text of our textbooks, for on Saturday last, the 22nd inst., oxygen was liquefied at Geneva, by M. Pictet, and M. Cailletet is stated also to have liquefied carbonic oxide and nitric dioxide, though we are bound to say that the accounts we have seen of the latter achievement are rather contradictory. The interesting news was telegraphed to Prof. Tyndall, who made them the property of all the world by a communication to *The Times*, and we now give the circumstantial account of Pictet's experiment, from the *Journal de Geneve*. It says:

"One of the most interesting experiments in physics made in our time has been carried out here with great success in the laboratory belonging to the Scientific Instrument Company. Our fellow-citizen, M. Raoul Pictet, has succeeded by the help of ingeniously-disposed apparatus, in obtaining oxygen in the form of a liquid. By a double circulation of sulphurous acid and carbonic acid the latter gas, as is well known, is liquefied at a temperature of 65° of cold under a pressure of from 4 to 6 atmospheres. The details of the experiment are then as follows: The liquefied carbonic acid is led into a tube four meters in length; two compound-action pumps make a barometric vacuum in this acid, which solidifies owing to the difference of pressure. In the interior of this first tube, containing the solidified carbonic acid, passes a smaller tube, in which there circulates a stream of oxygen. The oxygen is yielded by chlorate of potass in a strongly made cylindrical generator with egg-shaped ends. The generator will resist a pressure of 800 atmospheres. On the morning of the 22nd the apparatus as described was put in proper trim, and when the pressure reached 300 atmospheres a jet of liqnid oxygen spirted from the end of the tube at the moment when the compressed and frozen gas passed from this high pressure to that of the atmosphere. The great interest of the experiment lies in the experimental demonstration supplied by it of the mechanical theory of heat, aiding as it does in the proof that all the gases are vapors capable of successive transmutation from the gaseous to the liquid, and from the liquid to the solid form. About a fort night ago M Cailletet succeeded in liquefying the binoxide of nitrogen, under a pressure of 146 atmospheres, at a temperature of 11° of cold. Now that M. Raoul Pictet has liquefied oxygen there only remain hydrogen and nitrogen to experiment upon. It is intended to repeat Saturday's experiment, with some slight change in detail, on the next Monday and following days."

The degree of cold is not mentioned in the above hurried report. From Prof. Tyndall's telegram it appears to have been 100° C.; the pressure in the telegram is given 320 atmospheres, not 300. *The Times*, in its Paris letter, repeats the version of 320 atmospheres, and carries the temperature down to 140 C. of cold, and adds that M. Cailletet has liquefied "not only oxygen, but oxide of carbon." Further details will reach us in due course, when we will lay them before our readers. Meanwhile, we congratulate them on their Christmas gift from Geneva.—*Iron*, *Dec.* 29, 1877.

The Accuracy of Gas Meters.

We cannot agree with those who urge that there is no necessity for inquiry before legislation for the amendment of the Sales of Gas Act is proposed; but at the same time, we may admit that the provisions required for that amendment are few and simple. There are three parties interested in the question. First, there is the general body of gas consumers who, for the most part, understanding nothing about the construction of a meter, too often only regard it as an instrument of extortion, and these require to be assured that the meter affords a reliable indication of the quantity of gas consumed. The instances in which the integrity, as we may say, of the meter is impeached are, in reality, very few, when we take into consideration the enormous number in use; but when a case does occur, it makes a great noise. Every consumer who reads the newspapers gets an impression that he is an aggrieved party. A general suspicion is aroused, as happens to-day, and nothing can allay it but some authoritative declaration that the meter is, in the vast majority of cases, to be depended on. That reassuring statement cannot be satisfactory to the public unless it comes from a body of Commissioners, or a Select Committee who have carefully considered the matter. The parties next interested are the meter manufacturers, who may almost be said to be on their trial. Allegations have been made, and on official authority, that in a few rare instances, by some oversight, mistakes have been made in the registering part of the apparatus. The cases have been very rare, so far as we know, and, as we have said before, these mistakes have not benefitted the gas company who owned the meter. It is due, therefore, to the meter makers that they should have the opportunity of explaining how these accidents arise, and of satisfying the public as to their rarity. Lastly, it is due to the gas companies, who buy and supply most of the meters in use, that they should be allowed to establish their *bona fides* in the matter. They do not, as a rule, make meters. They replace them when they are complained of, and repair them when they are found to be defective. It is, of course, a public misfortune that the meter cannot be as accurate a measure as a quart pot, and that the works cannot be regulated like those of a watch or a clock; but we are certain that the investigation we call for would disperse all the doubts which at the present time agitate the minds of gas consumers.

It must not, however, be supposed that the consumers alone suffer from mistakes or defects in the construction of the registering apparatus of meters. In our issue for July 21, 1874, will be found reported the case of the "Imperial Gas Company vs. Hammond," which was heard at the Clerkenwell Police Court. The company sued the defendant, who used his own meter, for the value of 20,000 feet of gas. In this instance it was "accidentally" discovered that the wheel of the meter, which registered hundreds of thousands, had sixty-three teeth, when it should have had only sixty. The consequence was that at every revolution it registered five thousand feet less gas than was consumed. Now, it is impossible to suppose that a pattern was made for one particular casting, and we are certain that no meter maker would lend himself to a fraud of this kind. The probabilities are that a blunder was made by a stupid pattern maker, and that there are a large number of meters in use having a similar wheel. We quote the above as a proved instance in which a gas company suffered from an error in construction, and we adduce it as well, as an illustration of the necessity for legislation compelling the examination of registering apparatus before meters are stamped as correct.—*Journal of Gas Lighting, Oct.* 2.

Composition of Gas from Lime Kilns.

BY G. CARÉ ROBINSON AND J STUART THOMSON.

Some time ago a statement appeared in the CHEMICAL NEWS, vol. xxxv., page 208, to the effect that the gases liberated from lime kilns consisted almost entirely of carbonic oxide (CO), to the exclusion of carbonic acid (CO_2). As this appeared to us to be contrary to generally accepted opinion, and having lately had facilities afforded, we were induced to examine the gases evolved from some kilns in this neighborhood.

The limestone burnt consists of the varieties known as "blue" and "white." The seam, which is a thick one, runs below a bed of shale, and contains a considerable quantity of organic matter, chiefly of a bituminous character. The subjoined analysis of the two varieties cause them to be classified as what is technically known as "fat."

	"Blue."	"White."
Carbonic acid CO_2).....	41·618	43·911
*Lime.....	51·681	54·077
Magnesia.....	1·078	traces
Ferrous oxide.....	0·652	0·656
Alkalies.....	0·415	traces
Organic matter.....	1·874	1·243
Silica.....	2·745	0·482
	100·063	100·369
* Equal to Carbonate of Lime	92·287	96·566

The samples of gas examined were, in both cases, taken from the top of the charge; that marked I. was drawn at 11.30 a. m., one and a half hours after charging, the kiln being then in full operation; that marked II. was drawn at 3.30 p. m., while charging was going on; these periods being selected with a view of giving an idea of the composition of the gases throughout the whole period of reduction.

We would only further remark that carbonic acid (CO_2), carbonic oxide (CO), and oxygen were alone determined, the difference being stated as residue, which may be assumed to consist of nitrogen mixed with small quantities of hydrocarbons.

Volumes at 0° C. and 760 m.m.

	I.	II.
Carbonic acid (CO_2).....	27·04	7·05
Carbonic oxide (CO)....	8·09	5·76
Oxygen —.....	0·17	4·40
Residue.....	64·70	82·79
	100·00	100·00

University of Edinburgh.—*Chemical News.*

The new Engine at the Lake View, Ill., water works is now running, after being inspected and tested by the committee appointed by the Village Trustees, a few days since, a report of which will be presented at the next meeting of the Board. The average quantity pumped daily is 320,000 gallons, and the new pump does the work on one-half ton of screenings daily. The pressure test will be made at some future day.—*Engineering News.*

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WEDNESDAY, JANUARY 16, 1878.

Official Report of Examinations of Gas for three Weeks ending Jan. 12, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Date. Dec. 1877.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
24	Between 10 A. M. and 3 P. M.	16.57	16.53	18.98	17.05	16.44	
26		17.02	17.03	18.42	17.01	16.89	
27		16.23	16.27	18.76	18.49	16.27	
28		16.32	16.74	17.83	17.21	16.62	
29		16.98	17.42	18.79	17.18	16.56	
	Average	16.66	16.79	18.55	17.39	16.55	
31		18.10	16.52	19.21	17.17	16.34	
1878 Jan 2		15.96	16.58	19.89	16.46	16.15	
3		16.10	16.64	19.10	16.76	16.28	
4		16.36	16.50	19.55	16.96	16.66	
5		16.06	16.92	17.16	17.19	16.56	
	Average	16.51	16.63	18.98	16.91	16.39	
7		15.51	16.28	20.25	17.35	16.44	
8		16.71	16.91	20.03	17.04	16.33	
9		16.21	16.39	18.18	17.29	16.40	
10		16.11	16.27	18.10	17.18	16.55	
11		15.29	16.00	18.71	17.02	16.23	
12		16.58	16.17	17.85	17.25	16.50	
	Average	16.07	16.33	18.84	17.19	16.41	

Sugg-Letheby burner.

E. G. LOVE, Gas Examiner.

Gas-Light Intelligence.

United States.

"How much is a meter?" asks a Cleveland paper. Wait till the gas man comes around, he'll give you liberal figures.—*Exchange.*

CHICAGO, ILL.—The gas companies of Chicago have accepted the terms of the council of $1.65 for the South side, and $2 for the West side per 1000 feet.—*Engineering News.*

A NEW GAS COMPANY.—A new gas company is being organized in Jeffersonville, Ind., with a capital stock of $25,000. Many citizens have subscribed. This company will apply for a charter soon. The company propose to carry on its business in the towns of Port Fulton, Clarksville, and Ohio Falls, as well as in the city of Jeffersonville.—*Ibid.*

GALVESTON.—Alfred F. James, Ephraim McHean, and their associates, have been authorized by the City Council of Galveston to supply that city with gas for twenty-five years. The ordinance is quite too lengthy for publication in our columns, but may be found in full in the *Galveston News* of the 5th inst.—*Ibid.*

FREIGHTING.—One thousand tons Scotch cannel recently arrived per sail, on a freight of three shillings sterling. Out of this the vessel had to pay thirty cents per ton to the gas company, at whose dock she was discharged for unloading. Highly profitable freighting!—*Coal Trade Journal.*

ELECTION OF DIRECTORS.

MANHATTAN GAS LIGHT COMPANY.—Moses Taylor, Samuel Sloan John J. Cisco, John R. Ludlow, Percy R. Pyne, Mason Young, Wilson G. Hunt, James H. Young and Charles Roome.

METROPOLITAN GAS LIGHT COMPANY.—Oscar Zollikoffer, R. H. Arkenburgh, Thomas T. Buckley, John R. Cecil, Albert Cornell, John P. Huggins, D. H. McAlpin, A. C. Peck, George F. Victor, Augustus Schell, Sam. Willets and O. F. Zollikoffer.—*N. Y. Herald, Jan.* 15, 1878.

OFFENSIVE GAS.—Most people wondered, while passing by the City Hall during the last week or so, where the very offensive smell came from, which they perceived when in that immediate vicinity. The general conjecture was that it emanated from a small army of skunks which had suddenly invaded the city. We came to that conclusion ourselves, but it has just been discovered that the gas manufactured by the new process, and supplied by the City Gas Co., is the cause of the bad odor. And it still continues to emit it with all its might.—*Daily State Gazette, Trenton N. J., Jan.* 1.

Great Britain.

AITKIN AND YOUNG'S PROCESS.—We do not often allude to new companies, but may mention here the formation of the "Universal Gas-Light Improvement Company," which has been formed with a view to develop the use of Aitken and Young's patented process. This process has been more than once described in our columns, and we have expressed a qualified opinion, that when a gas company have not a ready outlet or sale for the tar they make, the process may be employed, first, to increase, to a small extent, the volume of the gas produced, and next, to improve its illuminating power. We have only to add that, when the tar has been employed according to the patent, it is still valuable for everything but distillation for naphtha. All other ingredients of worth remain. There is one feature in the prospectus, and it is, in fact, the one which chiefly induces us to give a notice of the company. The projector—for he seems to stand alone—is to receive no cash payment until the shareholders receive a 10 per cent- dividend. This is an example of good faith and confidence, which is in striking contrast with some enterprises we have had occasion to notice.—*Journal of Gas Lighting.*

STREET LIGHTING WITH OIL IN ENGLAND.—There is a gas row at Carshalton, and, as a consequence, the public gas lamps have not been lighted for some nights. Regretting as we do the constant squabbles of gas companies, which might, we think, in most cases, be obviated in a very simple way, we do not at all regret the extension of the use of petroleum for public lamps. All things find their level, and a short experience will teach authorities that, after all, gas is in every respect superior to, and cheaper than petroleum. Experience, as some authorities have already found, is at times dearly bought, and some, we expect, will have to regret the day, or night, on which they resorted to petroleum.—*Ibid.*

THE PRICE OF GAS FOR PUBLIC LAMPS IN ENGLAND.—The quarrels of gas companies with local authorities as to the price at which public lamps shall be supplied is leading to an extension of lighting by petroleum oil. At present, we believe, Winchester, Poole, and Barking, are lighted by means of oil lamps. The Romford Local Board have recently decided to adopt oil, and the Corporation of Bristol and the Local Board of Guisborough are considering whether or not they shall adopt the same system. A deputation from the Corporation af Bristol went to Winchester last week to see and learn for themselves all about petroleum lighting. They found, we understand, that the light given by the lamps, though whiter and brighter than that afforded by gas, did not diffuse well, and that the reservoirs at the bottom of the lanterns, even when made of glass, cast a deep shadow immediately under the lamp. They were told that, for the present year, the contract for lighting the city is 10 per cent. less than that offered by the gas company; but it was judiciously pointed out to them that next year the conditiens may be reversed. The increased use of petroleum must necessarily lead to an increase of price, and the well-owners in Pennsylvania take every opportunity of adding to their rate of charges. There is a strong opinion that the wells will not last out many years, and the necessity for "making hay while the sun shines" is generally recognized by the lucky people who have "struck ile." We shall be told, of course, that there is petroleum all over the world; but when it is brought to England from other sources than America, what will it cost?

Turning to the source of discord between local authorities and gas companies as to the supply of public lights, we find it is invariably a dispute about price. Now, cannot some arrangements be made which will be satisfactory to both parties? Most special Gas Acts enact that gas supplied to public lamps shall be charged for at the lowest rate paid by private consumers, except under special contract. But it is nowhere said that private consumers shall be charged for gas at the same rate as is paid by a local authority for a supply to public lamps. Travelling in Switzerland, some five and twenty years ago, we were greatly annoyed one day, at a *table-d'hote*, by the discordant din made by a band stationed in the *salle a manger*, and next morning we found in our bill a charge for "music." (?). We objected to the item. "Very well," said the bland landlord, "I will take it "out; but you will pay one franc more for your bed.—*Jour. of Gas Lighting.*

Barrow-in-Furness.—A large pocket of metal has been found at a place called Sandscale, where, hitherto, the existence of hematite was not known. This is an important event to the district, inasmuch as it indicates the existence of ore over a larger area than had been previously known; and it affords a proof of the almost inexhaustible bed of metal in the Furness district.—*Ironmonger.*

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publiction, unless desired, but as a guarantee of good faith.—Ed

Give Your Foreman the Journal.

December 28, 1877.

Mr. Editor: I enclose Post Office order for $7.80, of which $4.80 is for enclosed bill, and $3.00 for the Journal for 1878. Please send it to ————. He is my foreman, and I take this method of showing my appreciation of him, and indirectly, of benefiting my company, by making him more intelligent, and therefore a more useful servant. Yours truly,

* * *

[Among many commendatory letters which we have received, we publish the following as a model, which we would be very glad to see imitated. We hope many other managers will "go and do likewise."

There are many men about gas works who can be benefitted by the Journal, whose compensation is hardly adequate to meet the demands of daily life, and subscribe for many periodicals that they would really appreciate and enjoy.—Ed.]

Purifying Drinking Water.

Chief Engineer McFadden, of the Philadelphia Water Works, in his annual report, from which we have already given several extracts, gives the following information relative to the purifying of drinking water:

Water, though theoretically made up of only two elements, without perceptible taste, color, or smell, is never supplied by nature chemically pure. Analysis proves that it contains, in a greater or less degree, foreign matter gathered from many sources. It is only where these exceed a certain percentege that they become dangerous to the health of the community, and make a purifying process necessary to fit the water for domestic use. These impurities may be classified under three general heads:

I. Floating debris.

II. Mineral sediment.

III. Organic impurities.

Impurities of the first class are confined mainly to the surface, and are made up of floating wood, leaves, etc. A properly arranged system of screens will arrest them and obviate this trouble.

The second class is made up of such mineral sediment as is derived from the abrasion of rock, and the washing of the different soils forming the river basin. Unless present in very large and unusual quantities, these impurities are seldom injurious to health, but society demands clean-looking water, and the manufacturer often requires it; therefore it is well to get rid of this sediment whenever possible.

Subsidence or gravitation is the simplest plan to pursue, but requires a storage capacity of at least one week's consumption to give the particles time to settle.

It is in the third class of impurities—those derived from organic bodies—that we find the elements most dangerous to the community; and while their removal is of vital importance, they present the most formidable obstacles to the engineer.

The principal source of organic impuries is decomposing animal and vegetable matter, sewage, dissolved fertilisers, waste from manufactories, etc. These matters remain in suspension until decomposition has removed so much of their volatile natures that the mineral components can sink, but their really dangerous elements frequently so unite chemically with the water that no artificial system of filtration can separate them, and under the guise of pure limpid water they convey the seeds of disease to the consumer.

Subsidence will only partially remove organic impurities: oxidation, by exposing the water in thin sheets to the action of the air, as in running it over weirs, is beneficial; but even an elaborate and costly system of filter beds will not eliminate all these deleterious particles held in solution by the water.

The only true method of furnishing pure water is to maintain the purity of the source of supply, by diverting from it as much as possible all sewage, manufacturing refuse, etc. Economy and common sense should teach us that it is false in principle to first pour all manner of filth into our water supply and then attempt to get rid of it by costly and seldom efficient processes. The advice of an eminent authority is—

"If any water intended for domestic purposes is found to be charged with organic matter in solution, the very best plan of treatment is to let it alone, and take the required supply from a purer source."

The next best plan, when we have no available purer source, is to so perfect the system of sewers—the most fruitful source of dangerous organic impurities—that they discharge thrir contents, as far as possible, from the stream from which we derive our water supply.

The following is a brief sketch of the methods used for the purification of water:

Evaporation and the use of chemicals, though really the most effectual, cannot be applied economically to a large public supply. Simpler and cheaper methods must be relied upon.

Carbon, prepared in large plates, and so placed that the water must percolate through it, especially reacts on all organic matter, but when the demand is heavy this process is very expensive, owing to the large area of filter made necessary by the slow rate of progress of the water through the carbon plates, 3,300 square feet of the most porous being required to supply 1,000,000 gallons of filtered water per day.

In England magnetic carbide, made by roasting hematite iron ore with granulated charcoal, is used in layers of from 2 to 12 inches, in a sand filter bed, and is said to give wonderful results in removin organic matter.

Infiltration basins are used in a number of our towns and cities. These are simply galleries excavated in the porous margin of a lake or river, or in water-bearing sand formation, as at Brooklyn. These galleries are sunk below the water level, and are supplied by percolation. They are usually formed of two side walls, say eight feet apart, arched over, and of a length commensurate with the demand. The amount of water furnished by them depends on the porosity of the sand and gravel beneath and around them, and the head of water under which the filtration is maintained. When the location is favorable, and the volume required not too great, they are simple and effective.

Filter beds purify the water by passing it downward through intercepting strata of sand and gravel into a clear water basin beneath, from which it is supplied by pumpage to the consumer. They are much used in England and on the Continent, but their first cost and the constant expense of maintenance have discouraged their use in this country.

The requirements of an efficient sand filter bed may be briefly set down as follows, quoting from the most successful and economical practice:

Kirkwood, in his report of the St. Louis Water Company, recommends as of vital importance to the successful working of a filter bed, and as the first step in the system, the formation of a subsiding basin sufficiently large to hold at least one whole day's consumption of water, thus getting rid of the grosser particles by gravitation; this makes the filtration more economical, and is useful in time of flood and for storage.

The filter beds themselves are usually located at some convenient point on the river bank, or even in the river, if sufficiently protected from floods and from ice; but the great area required for a large supply and the consequent expensive nature of the protecting works, render the latter or river plan unadvisable, to say the least.

The filter area is subdivided into beds averaging 250 by 150 feet each, and should be not less than 12 feet deep. The sides and bottom must be made impervious by puddle clay or concrete. There are many plans of arranging the interior of the filter bed, but perhaps the best and most economical is one in which the entire floor area of each individual bed is covered with ranges of small brick piers placed a short distance apart, and sufficiently high to form a storage basin for clean water. Upon these piers rests a flooring of rough flagging laid with open joints, and this flagging supports in turn the layer of cobble-stone, coarse and fine gravel and sand, through which the water must pass by percolation. When the water flows into the filtering bed from the subsiding basin, all its impurities, except those in solution, are intercepted, and remain on the surface of the sand stratum which forms the uppermost of the filtering strata. The finer this sand the more perfect filter, but at the same time the slower its action The deposit of impurities on the sand clogs the filter, and must be removed at intervals of from one to eight weeks, depending on the condition of the water to be filtered. It is to make possible this clearing process, without stopping the supply to the consumer, that the filter is divided into independent beds, but this at the same time requires a surplus area sufficient to keep one or more beds constantly out of service.

Filter beds should be covered over, to protect them from ice in winter and the heat of summer, which latter especially, acting as it would on shallow and still beds of water, would render the supply unpleasantly warm, and promote vegetable growth in many objectionable forms. Experience has proved that filtered water must be used at once. Unless kept protected it soon spoils, much more readily than turbid water.

Humbar, Kirkwood, and other hydraulic authorities all unite in saying that, to be cleansed of its impurities and made potable, water should not pass through the filter bed at a more rapid rate of descent than 6 inches per hour, or 12 feet per day, and in this simple fact lies the expensive feature of the system, for to purify 1,000,000 gallons of water per day requires, at the above rate, 13,500 square feet of filtering area; and as the present maximum demand of Philadelphia is 75,000,000 gallons per day, more than 23 acres of filter beds would be needed, without counting the surplus area required for cleaning.

The above is a mere outline of the cheapest form of a sand filter. The actual cost of a perfect system of subsiding basin filter and clear water basin will vary with the nature of the site, the material and the volume of clear water required. The constant expense of attending these basins is likewise a serious item not to be lost sight of.

Dr. Medlock, of Amsterdam, strongly advocates the use of iron as a purifying agent. In experimenting in the canals of Holland, where the water is very impure, he found that iron gratings and strips of iron placed in the weirs reacted very energetically on water containing ammonia, or matter capable of yielding it, the organic impurities being precipitated by contact.—*Iron Age.*

Sewage, Drainage, and Disease.

A special session of the Philadelphia County Medical Society was held, on Wednesday, September 19th, at the hall of the College of Physicians, and matters bearing upon the health of the city were discussed. Dr. Richard A. Cleeman, in a report from the Standing Committee on Hygiene, introduced the subject of drainage and sewerage of the city as related to the prevalence of typhoid fever. Last year there were 200 deaths in New York from that disease, and here there were 774 deaths, although the population of the former city is 25 per cent. greater than that of Philadelphia. This contrast leads to particular inquiry here from a standpoint of local interest. An enumeration of the agents by which the specific poison that brings about the fever is supposed to be produced, led to a review of the system of drains. Dr. Cleeman be-

lieved that the system now in use here does almost nothing to prevent the spread of typhoid fever, but that on the other hand it does little toward its direct development. It is desirable, however, that the sewers be so constructed as to carry off all organic refuse, which they now fail to do.

Dr. Benjamin Lee spoke upon the garbage nuisance. Typhoid fever, he assured the society, is inducing mortality at a steady rate of increase. It is no epidemic wave, but some inherent fault that causes the zymotic disease to take such impetus to itself. The garbage man is a great helper on of the fever. Follow his loaded, or even his empty cart around and your nose convinces you that the atmosphere is being vitiated. Servants leave the garbage barrels uncleaned and stinking. The odorless excavator was an improvement on the old way of cleaning cesspools, and sets a good example in the matter of garbage, which must be disinfected and deodorized as it is placed in a receptacle for removal. It is to be hoped that before many years the health authorities may devise some such improved means of removing the decomposing and rotten garbage. As swill-milk is poisonous, so the meat from cattle or hogs fed with this stuff is productive of disease also. He did not agree with Dr. Cleeman in the belief that the drinking water of Philadelphia is entirely inocuous, and thought that all drainage above the Schuylkill dams should be made through intercepting mains, or else typhoid fever will increase as heretofore. In a general discussion that followed it was mentioned that drinking water is delivered to the residents of the Twenty-ninth ward from the Belmont works, which take their supply directly from the river without going into the reservoir. Dr. Burns of that locality, pronounced the water to be the most foul-smelling of any used for drinking in the world, and concluded that if typhoid is solely caused by such impurity the Twenty-ninth ought to have three thousand deaths from that disease yearly. Dr. Cleeman said that an examination of the vital statistics of the city at the Health Office showed that there were four times as many deaths in that ward from typhoid fever as in any other ward in the city.

Prof. Pepper, of the University of Pennsylvania, called attention to the fact that the large increase last year in the death rate on account of typhoid fever was due to the many unacclimated persons in the city.

Dr. Parish threw out the point that large factories are frequently instrumental in choking up sewers with their refuse that should be carted away, instancing marble yards and their refuse sand.

Drs. Nebinger, Hamilton, and others also took part in the debate. The members of the society who spoke all expressed their conviction that decomposing sewage and deficient drainage are prolific sources of disease, and that the great mortality from typhoid fever which still prevails is largely due to this cause. The drinking water supply should be carefully watched in order to prevent the introduction of any decomposing organic matter in which the typhoid fever poison is generally found.—*Philadelphia Times.*

The Brandon Ores and Paints.

The *American Mail* publishes, in a recent number, an account of the very interesting deposits of ore, kaolin, ochre, etc., near Brandon, Vermont:

The Brandon ore beds, located two miles east of the town, in Vermont, had been worked many years for superior iron and manganese ores before the minerals with which they are associated were utilized. The red hematite is deeply bedded in fine clays, silicates of alumina—which are stained by the oxides of the two ores. Both metals were extensively mined and well known in the market, and Brandon charcoal blooms in 1850 commanded the highest price of domestic iron. The necessary washing of ores to prepare them for the furnace, by the enterprise of one of the proprietors, led to the conservation of the colored clays which had been carried off by the stream and lost. Passing the current from the ore washer through a series of vats on the ground, it was made to drop the sand associatied with the clay and deposit the latter in vats more distant. Drained of its water there, the clay was conveyed to shelves under extensive sheds to dry in lumps or powder, then called *bole*, a clay colored with the oxide of iron popularly called an "ocher." However, ocher is a term applied to any metallic oxides occurring in an earthy or pulverulent form, as were probably the original pigments known to the ancients, being yet extant in Egyptian tombs and upon Indian rocks, where there permanence attests their value.

The atoms of the color being so minute that they enter the pores of most surfaces almost like a stain not easily to be washed off or faded by time, is a peculiarity that enhances the value of very fine clay used to give body with power to cover and fill surfaces when mized with thinner chemical colors that possess more tone but do not lay on so well. Being a novelty, they were named "Brandon Mineral Paints," and the popularity they soon made for themselves on their merits increased the demand for them to such a a degree that what was at first but a by-product to the mining of iron and manganese, was sought for in the neighboring deposits of clay adjoining the ore beds, and these have been worked ever since. Other iron ores and other clay beds are worked and washed for the like mineral paints, but not possessing the oxide of manganese, which is a natural "dryer" for paint oil, they have not equaled the original, though good enough for some purposes.

The series of clays in this locality is varied by their situation. For some years kaolin, or China clay, was dug from a bank at the surface, and from its resemblance to putty the Vermonters called it "mineral putty." In later times this comes from under the surface. Some of it is very white, plastic, and almost free from silica, but all must be washed and strained to be made thoroughly plastic and merchantable. Some of the sand deposited in the more distant vats is as fine as the pulverized silica of commerce.

Not far from this kaolin, white as snow, are found many shades of yellow clays, even approaching orange and red, and in spots elsewhere the metallic sulphides are exposed, appearing black when wet. By washing and drying, these produce raw umber, and when roasted are called burnt umber.

Yellow clays, after being dried on the shelves, are placed in the reverberatory oven and more thoroughly dehydrated. Every trace of sulphuric acid is expelled; the protoxide of iron becomes the peroxide as the carbonic oxide gas from the fuel is converted to carbonic acid, deepening the metallic colors by this "chemical" process. The light red shades first appear and gradually become dark red, light brown, dark brown, still deepening in proportion to the metallic oxides possessed by the clays and continuance of the roasting process. The same metallic oxides, artificially produced and similarly treated, without the presence of the clay or silicate of alumina, are known, to the trade and painters, as colcothar, trip, rouge, crocus martis, etc. By their brightness of color they are judged free from adulterations, but they are rarely as free from grit as the well-washed Brandons. These combine easily with their exotic cousins, combine readily with oil or water, and with lime to color mortar and cement.

Indeed, the roasted colors, being as dehydrated when fresh as hydraulic cement, will make, with one-third part wood ashes and a little water, an equally good mastic, possessing a set color. They are used also to color tiles, because they wear well and are unchangeable. With asphalt, tar, resins, gums, caoutchouc, gutta percha, etc., they freely unite to lessen viscosity and make them plastic for the manufacturer to shape into permanent forms, after which operation they readily dry. These clays have no affinity for moisture, and being almost elementary in composition, chemical agents common in the atmosphere, time and temperature, seem to produce no further changes.

Gas for Fuel.

In an article upon the subject of using gas for fuel, Prof. Van der Weyde says:

The demand for petroleum and gas stoves is growing rapidly, and it is stated that one manufacturer is selling 3500 a month. This is a certain indication that the people are anxious to favor some form of fuel more cleanly, convenient and economical than coal. When economy is spoken of, the term is used relatively, because whatever the price of coal may be, the gas made from it, will still be decidedly the cheaper of the two forms of fuel, all things considered. Of course when coal is low in price the gas will cost proportionately less than when it is high, so that the advantage is maintained however the material may be affected by the market. The advantages it would possess in the matter of cleanliness and saving of labor are too apparent to any one familiar with the dirty and hard work inseparable from the care of an ordinary furnace; but there is another feature involving so much comfort, as to deserve special mention: Under the present method of warming our houses the stove is shaken, coal is added, and the draft opened until a sufficient heat is attained; it is then closed and a gradual but constant change of condition goes on, and the room at length becoming uncomfortably warm, the same process has to be gone over again. Now, with a gaseous fuel, this difficulty would be obviated, for the flow could be adjusted to suit the weather, and a uniform temperature be attained day or night. The luxury, in a severe climate like this, of keeping the atmosphere of our rooms equable and after a night of zero, rising in a warm and comfortable room, will be appreciated by everybody who has experienced the opposite and shivered into his clothes of a winter's morning. Another very important improvement which would result from the burning of gas instead of coal, is the reduced risk of an escape into the air of the dwelling of deleterious gases injurious to the health. They are almost entirely the product of an imperfect combustion, which is inseparably connected with the burning of coal; although most of them escape through the flue of the chimney, very often a leak in the stove or pipe, or some fault in the flue itself, throws out some of these poisonous mixtures to be inhaled and breed disease. These very gases when properly mixed with the oxygen of the air consume thoroughly, and so are harmless, and we believe, as a sanitary consideration alone, that the use of gas would be a great advantage. This fact develops some other and to most people surprising results where gas is employed in cooking. Certain London engineers, after repeated expert tests, certify that not only is there less liability of a disagreeable flavor being imparted to food cooked over its flame, but actua investigation shows that meats and other dishes so cooked lose less in weight than when coal or wood is employed. We think, however, that gas stoves, as at present constructed, without any escape pipe for the waste product, are faulty, and on this point we may have something further to say in the future.—*Mining and Scientific Press.*

NOTE.—No gas stove should be used for heating without a pipe leading the products of combustion by the chimney, flue, or otherwise out of the room into the open air.—ED.

Prices of Gas Coals.

The receipts of caking coal are now almost entirely confined to Westmoreland and Penn coal on last summer's contracts. We note the arrival of 400 tons Newcastle by steamer, and 700 tons Block House coal from Cow Bay, also by steamer. Shipments from the latter port in January are quite unprecedented.

The high water freights from Richmond have caused a cessation of shipments of caking coal from that

port. The following quotations will not likely be altered for the next sixty days.

Westmoreland	$5.50	$4.50	at Baltimore.
Penn	5.50	4.50	
Despard	5.35		
Marion	5.35		
Murphy Run	5.35		
Newburgh Orrel	5.35		
Ches. and Ohio RR. Caking Coal	5.40	$4.10 f. o. b. at Richmond.	
Block House	4.50	1.75	Gold f. o. b. at Mines.
Glace Bay	4.25	1.60	
International	4.25	1.60	
Clover Hill	4.00		
Cannelton Cannel	10 00		
Peytona	10.00		

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.

(with W. B. Scott & Co.,)

24 Pine Street, New York City.

January 16, 1878.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Central, Westchester	466,000	50	90	95
Harlem	$1,850,000	50	97	100
Manhattan	4,000,000	50	205	210
Metropolitan	2,500,000	100	130	133
" Scrip	$1,000,000	..	100	103
" Bonds	500,000	1000	92½	95
Mutual	5,000,000	100	90	92½x
" Bonds, gold.	900,000	1000	105	—
Municipal	1,000,000	100	90	100
New York	4,000,000	100	115	120
Suburban, W'steh'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	155	160
Citizens	1,200,000	20	75	80
" Scrip	320,000	1000	95	97½
Peoples	2,000,000	10	—	40
" Bonds	$ 325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	—	78
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	120	125
" Scrip		...	100	103
Union Co. E N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	80	90
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md.	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	--
Cincinnati G & C Co				190
Derby of Conn.	160,000	100	60	80
East Boston, Mass.		25	132	--
Fort Wayne, Ind.		100	...	—
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn.	700,000	25	184	186
Hempstead, L. I.	25,000	100	...	—
Jersey City	386,000	20	155	165
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown Maine	400,000	100	60	85
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.	1,200,000	100	100	110
Long Branch		20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	-	27
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	—	56
" Bonds			106	--
Perth Amboy		25	--	95
Rochester, N. Y.		100	50	60
Woonsocket, R. I.	150,000	100	100	...

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CLAY RETORTS,

By GEORGE W. EDGE, Engineer of Jersey City Gas Light Company.

Having been fully tested by many Gas Companies in the United States and England, this method is ubmitted to Gas Managers with the fullest confidence that it will accomplish the desired result at the smallest possible expense and inconvenience.

Among many others the process is now in use at the following Works:

Manhattan Gas-Light Co., New York.
Brooklyn Gas-Light Co., Brooklyn.
Boston Gas-Light Co., Boston.
Charleston Gas-Light Co., Charleston.
St. Louis Gas-Light Co., St. Louis.
New Orleans Gas-Light Co., New Orleans, La.

For particulars address as above—

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Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn.	50,000	50	—	26
Saugerties, N. Y.	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97

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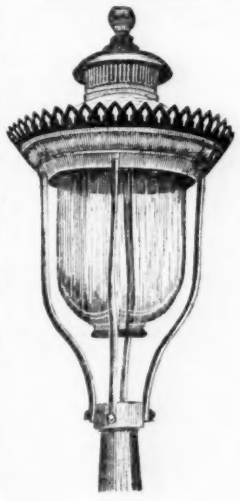

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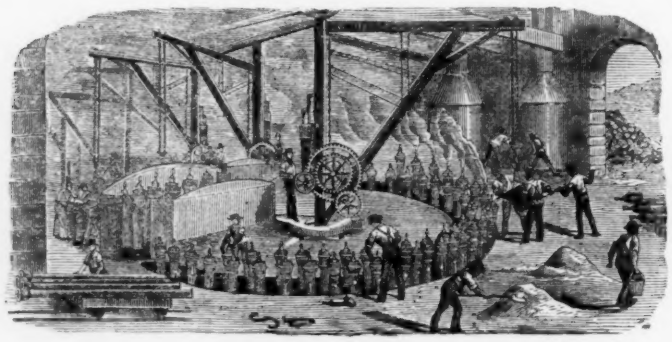

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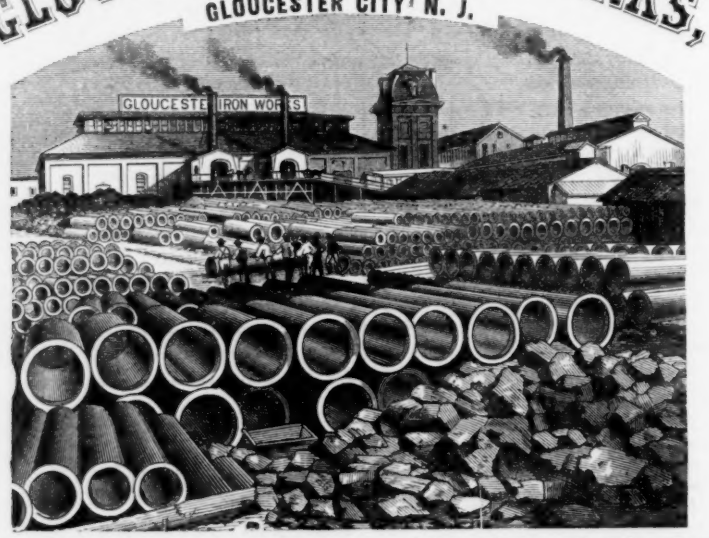

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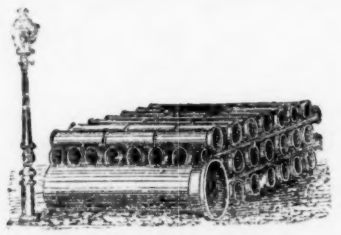

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351-1y

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Mines at Newburg, Preston County, W. Va.
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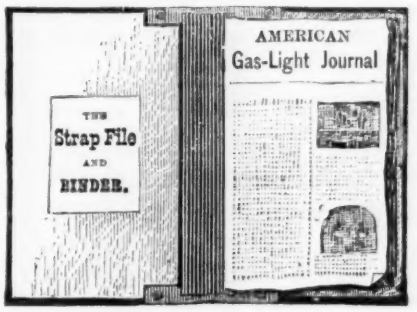

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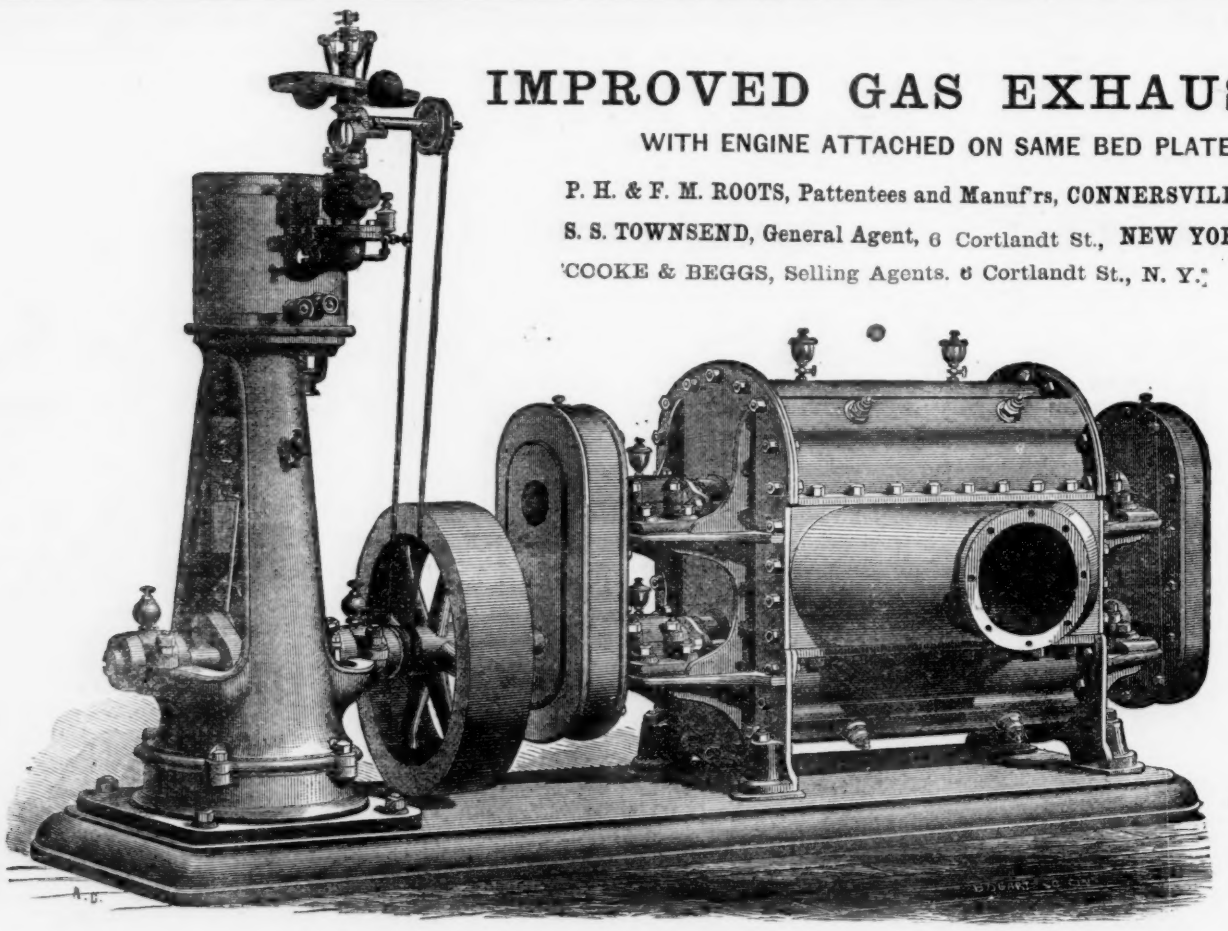

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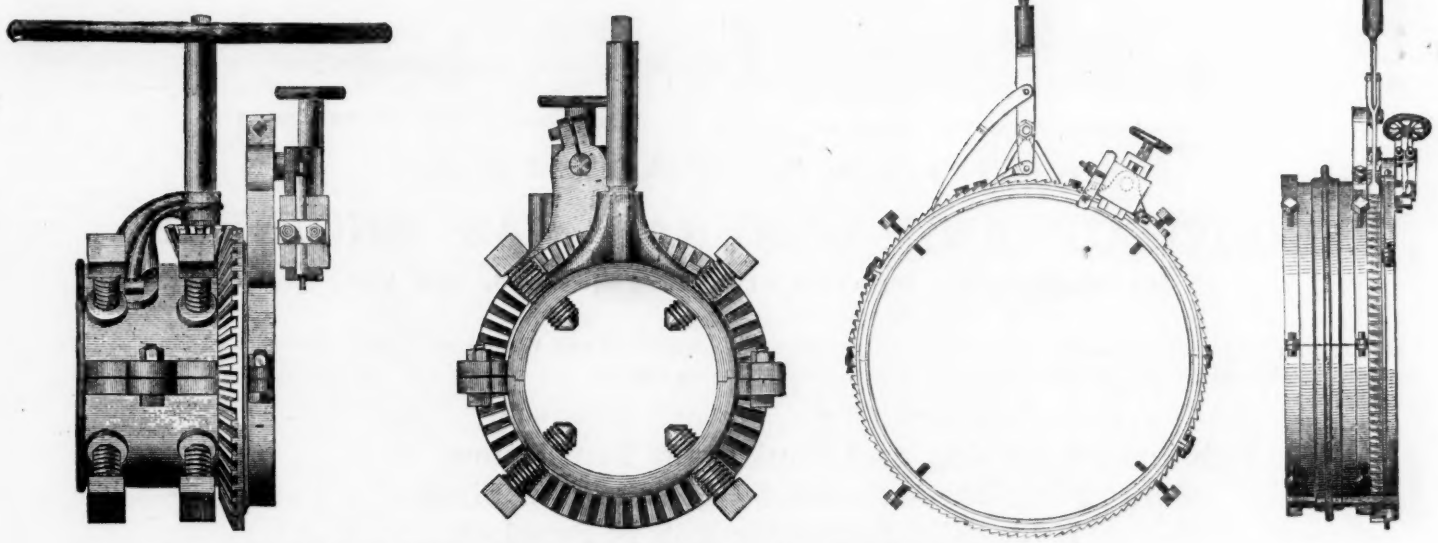

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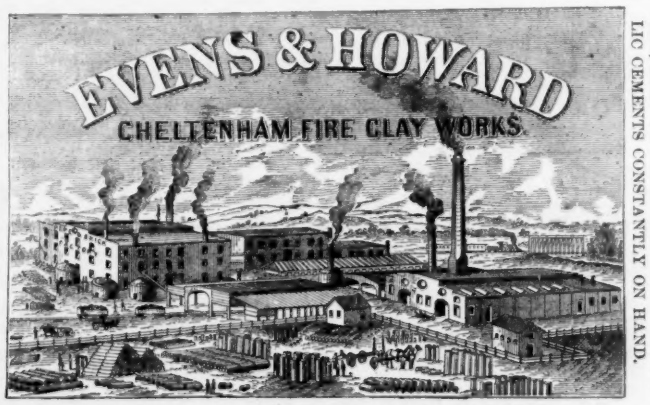

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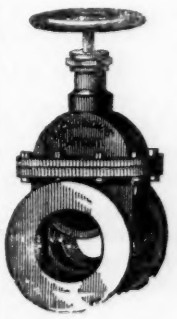

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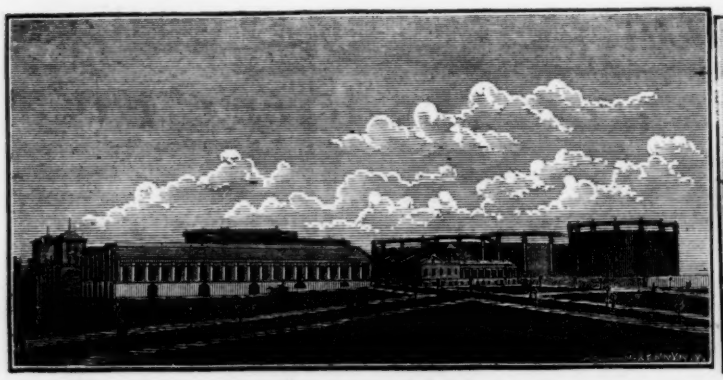

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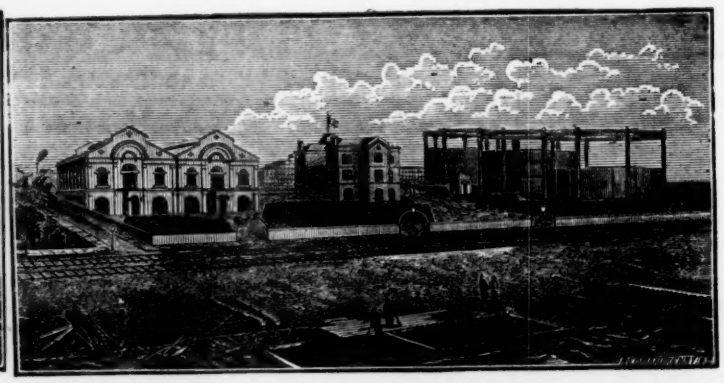

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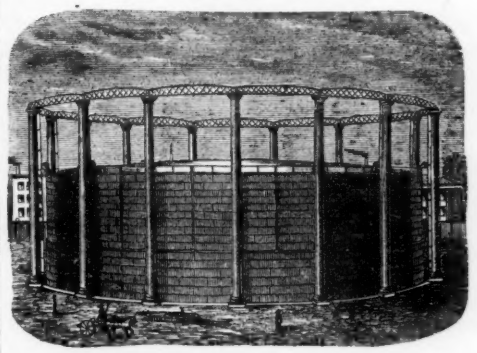

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434—1y

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Attest—J. L. CAMPBELL, Secretary, pro-tem.

Signed—A. T. GOSHORN, Director General

J. R. HAWLEY, President.

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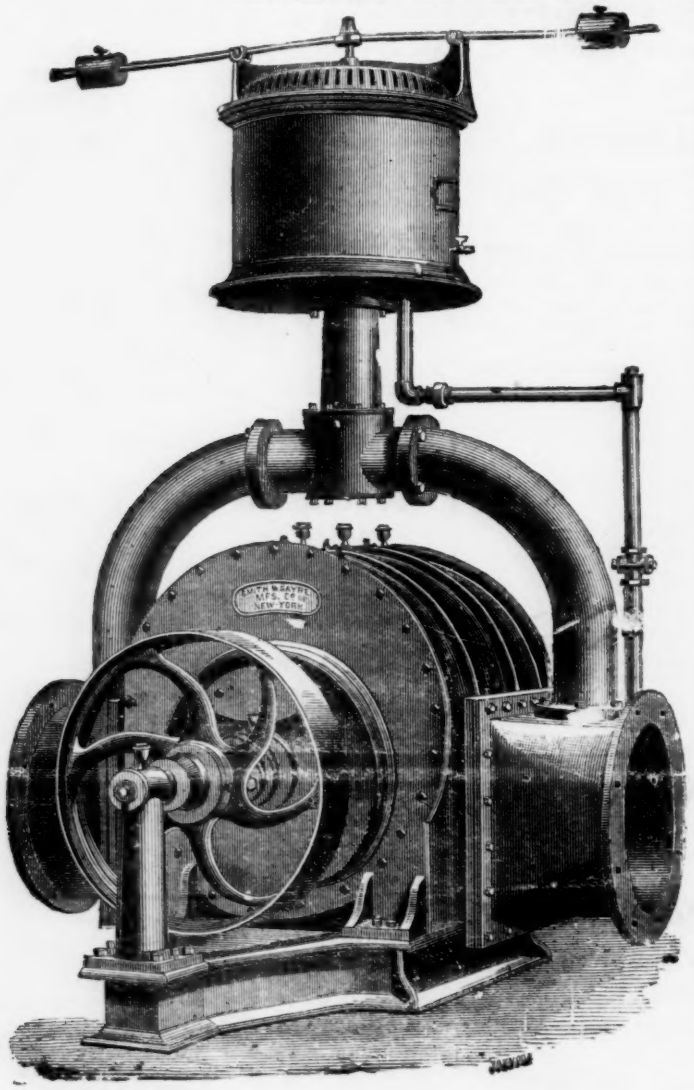

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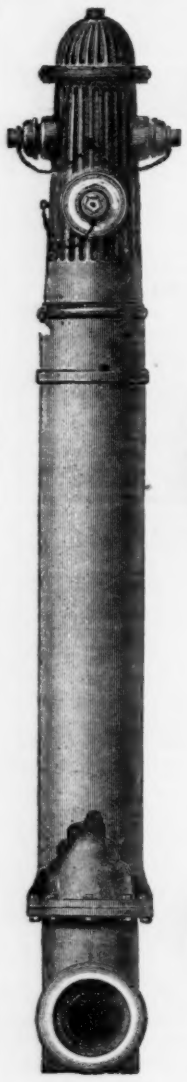

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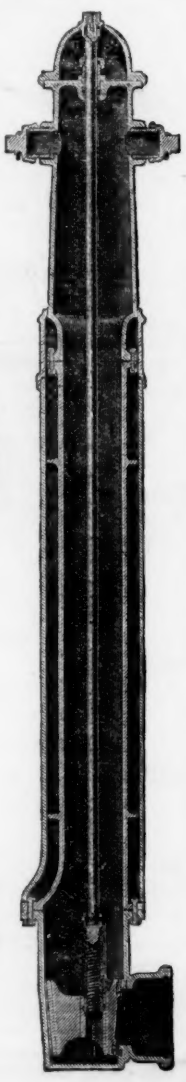

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